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ART. I.—*Migrations in the Pacific Ocean*, from the volume on the Ethnography and Philology of the U. S. Exploring Expedition under CHARLES WILKES, U. S. N.; by HORATIO HALE, Philologist of the Expedition. 1846.

THE work by Mr. Hale from which we gather the following facts and conclusions respecting the migrations of the islanders of the Pacific Ocean, bears evidence throughout of great labor, directed by a clear and philosophical mind. The first 225 pages are devoted to Ethnography, or an account of the customs, religion, civil polity and origin of the nations of the several countries and islands visited by the Expedition. The remaining 440 pages comprise the Philology of the same regions. The various dialects of Polynesia are treated of under the general head of a Comparative Grammar of Polynesia, followed by a Polynesian lexicon. The languages of the Feejee Islands, the Kingsmills, Rotuma, Australia, and northwest coast of America, and some dialects of Patagonia and southern Africa, come next under consideration. We feel assured that a glance at the work will excite surprise in all at the amount of information collected, and pleasure at the system and perspicuity with which the whole is presented.

In common with many others, we had expected but little more than a few imperfect vocabularies from this department in the Expedition. But this view arose from ignorance of the advan-

tages for collecting information which the philologist would find at his command. On every island visited, interpreters were at hand, for the shipping of the seas had scattered sailors through all the Pacific groups; and even in the imperfectly known Feejees, there was an Irishman who numbered forty years among these natives. Besides, in very many of the dialects, the languages had been written out and works printed by the missionaries of those seas. By these aids, even the intimate structure of the languages could be thoroughly studied. A philologist was needed to visit the wide-spread groups of the Pacific, gather up the information to be obtained from different sources, and present a general and comprehensive view of the languages of the ocean; and for this task Mr. Hale was well fitted: we can bear testimony from personal knowledge, to his industry, his calm judgment, and his careful scrutiny in the collection of facts; as to the rest, the work speaks for itself. It is an honorable monument alike to the author, the Expedition, and the country.

The Polynesians spread over the greater part of the Pacific Ocean. Twelve hundred miles north of the equator lie the Sandwich Islands, one of the Polynesian groups, and two thousand two hundred miles south of the line, another of the same—New Zealand. Between these limits, as will be seen on the accompanying chart, or rather between the equator and the latitude of New Zealand, there are the Friendly Islands, the Society Islands, Hervey Islands, Austral Islands, Gambier or Mangareva group, Marquesas or Nukuhivan, Paumotu Archipelago, Union or Fakaafo group, and some other scattered islets. The population as stated by Mr. Hale is as follows:—

Samoan or Navigator Islands, . .	56,000
Friendly or Tongan Islands, . .	18,000
New Zealand, ...	150,000
Society or Tahitian Islands, . .	20,000
Hervey group, ...	14,000
Austral Islands, ...	1,000
Gambier or Mangareva group, . .	2,000
Paumotu Archipelago, . . .	8,000
Marquesas or Nukuhivan Islands, .	20,000
Sandwich or Hawaiian Islands, . .	100,000
Union or Fakaafo group, . . .	1,000
	380,000

The whole number, adding the scattered islands, is far below half a million.

The languages spoken at these several groups are closely related dialects of one language, a branch from the Malay of the East Indies. In no instance do they differ more decidedly than the Spanish and Italian languages, and usually the dissimilarity is much less. We cite the first few paragraphs, commencing the chapter on Orthography, to illustrate some of the analogies.

"The elementary sounds proper to the Polynesian languages are fifteen in number, namely, the vowels *a*, *e*, *i*, *o*, *u*, and ten consonants, *f*, *k*, *l*, *m*, *n*, *ŋ*, *p*, *s*, *t*, *v*."*

"The only dialect, so far as is known, in which all these letters are found, is that spoken in the two groups of *Fakaafo* (Union) and *Vaitupu*. In the other dialects some of these letters are dropped entirely, and others changed.

"In *Samoan*, the *k* is dropped, its place being indicated merely by a hiatus or catching of the breath, as *ali'i* for *aliki*, *'a'ono* for *kakono*.

"In *Tongan*, the *k* is retained, but the *s* is changed to *h*, as *hahake* for *sasake*, *aho* for *aso*. The *t* in this dialect, when it precedes *i*, has a sound not unlike the English *ch*, or like *ti* in *Christian;* the missionaries have represented this sound by a *j*, as *jino* for *tino*, (pron. *chino*.)

"The *New Zealand* dialect changes the *s* to *h*; the *l* to *r*; the *v* to *w*; and the *f* before *a* and *e* to *w*; before *o* and *u* to *h*; and before *i* commonly to *w*, but sometimes to *h*: as *heke* for *seke*, *waka* for *vaka*, *ware* for *fale*, *vetu* for *fetu*, *hoe* for *foe*, *huri* for *fuli*, *witi* for *fiti*, and *hia* for *fia*. If two *f*'s occur in the same word, preceding an *a* or an *e*, the first *f* is usually changed to *w*, and the second to *h*; as *waha* for *fafa*, *wehe* for *fefe*.

"The dialects of *Rarotonga* [Hervey group] and *Mangareva* [Gambier group] lose both the *f* and the *s* entirely, and have *r* instead of *l*; as *are* for *fale*, *ae* for *sae*.

"The *Paumotuan* has the same elements as the New Zealand, except that the *f* is sometimes heard in the place of the *w*. Many of its words assume peculiar forms unlike those of any other dialect, as *mateu* for *matou*, *mauŋa* for *maua*. The *k* is sometimes introduced in words where it does not properly belong, as *reko* for *reo*, *kakuenei* for *akuenei*.

"The *Tahitian* dispenses with both *k* and *ŋ*; the *s* is changed to *h*; the *f* before *a* and *e* is commonly though not always retained; before *i* and *u* it is replaced by *h*; the *r* also is used instead of *l*; as *ari'i* for *aliki*, *rai* for *laŋi*, *fa'a* for *faka*, *hou* for *fou*.

"In *Hawaiian* [Sandwich Islands], *f* and *s* are changed to *h*, *ŋ* becomes *n*, *w* is used for *v*, (though the sound is properly intermediate between the two,) and the *k* is dropped, as in Samoan and Tahitian; as *hale* for *fale*, *lani* for *laŋi*, *wa'a* for *vaka*.

"The *Nukuhivan* [Marquesas] varies in different islands, and even in different districts of the same island. In Tahuata and the other southern islands the *f* is retained; the *ŋ* becomes *n*, and the *k* is frequently omitted. In Nukuhiva, and

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* The vowels are pronounced as in Italian, *ah*, *ay*, *ee*, *o*, *oo*. The letter *ŋ*, (a Greek letter, but much resembling that used by Mr. Hale,) has the sound of *ng*.

the rest of the northern cluster, the *f* is changed to *h*, the *k* is retained (except at the beginning of words, where it is omitted or retained at the pleasure of the speaker,) and ŋ becomes *k*, except with the people of one district, (the Taipis,) who give it its true sound. In all the islands the *l* (or *r*) is omitted, or at least is very rarely used. Thus we have in Tahuata *fiti*, *fae* (or *hae*,) *hana* for *hawa*, and *Havai'i* for *Savaiki;* in Nukuhiva, *hiti*, *hae*, *haka*, (or with the Taipis *hana*,) and *Havaiki*."

The facts here quoted, while they exhibit some of the relations of the dialects, are important in fully understanding Mr. Hale's arguments. Without farther introduction we give an abstract of his results, by citations from the eighty pages over which the subject extends, though we find much difficulty in making a selection from his succinct and highly interesting chapters.

The discussions relate not to their primitive seat, which is acknowledged to be the East Indies, but to the point of radiation in the Pacific ocean, or the island or group first inhabited, "and which bore to the rest the relation of the mother country to its colonies."

"The first result of a careful investigation, is to produce the conviction that the progress of emigration was from west to east, and not in the contrary direction. This conclusion may be deduced merely from an examination of the comparative grammar and vocabulary of the various dialects. We see in those of the western groups many forms which are entirely wanting in the eastern tongues; others which are complete in the former are found in the latter defective, and perverted from what seems evidently their original meaning."

"Other comparisons serve to confirm this general deduction. We find in the west a comparatively simple mythology and spiritual worship, which in the east is perverted to a debasing and cruel idolatry. The fashion of tattooing, which, in Samoa and Tonga, is intended to answer the purposes of decency, has degenerated elsewhere into a mode of ornament. Other facts of a similar nature might be mentioned, but it will hardly be thought necessary. One circumstance however must be noted, which becomes apparent in this investigation. The people of the Tonga or Friendly group, though belonging to the Polynesian family, form a class apart from the rest. This is seen in their language, which differs strikingly, in several points, from the others, especially in the article, the pronouns, and the passive voice of the verb. Several of their customs are, moreover, peculiar, such as that of infant sacrifice, of cutting off a finger to appease the gods, their mode of canoe making, &c. It is evident that these islanders have received modifications in their language and usages, from a source which has not affected the rest. We shall for the present leave this group out of the question in our discussion, and recur to it hereafter."

The possibility of navigating canoes eastward, opposite to the course of the trades, is an established fact, and a supposed difficulty in this view of their migrations is set aside. During a large part of the winter months, westerly winds prevail over the tropical regions and extend as far east as the farthest limits of the Paumotu Archipelago. The Tonga people in their intercourse with the Feejees, which is still sustained, take the trades in going to the Feejees, a distance of two hundred and fifty miles, and wait for the westerly winds to carry them back. Among instances of voyages to the east "we have the remarkable case of Ulea, in the Caroline Archipelago, who was found by Kotzebue, in 1817, on the island of Aur one of the Radack chain, to which he had been driven in a canoe with three companions, a distance of nearly 1500 miles due east. Beechey in like manner found on Barrow Island, in the Paumotu Archipelago, some natives of Chain Island, who had been drifted by the westerly winds 600 miles."

"On our arrival at the Navigator Islands, we there saw the newly published work of the Rev. John Williams, entitled, "A Narrative of Missionary Enterprise in the South Sea Islands." Of the mass of information which it contains, I was especially struck with that relating to the peopling of Rarotonga, the inhabitants of which consider themselves to have descended in part from emigrants from the Navigator group. At another of the Hervey Islands, *Aitutaki*, the inhabitants believe that their ancestors ascended from a region *beneath*, termed *Avaiki*. This account called to mind a similar tradition of the Marquesans, who gave to the lower region the name of *Havaiki*. (Stewart's Voyage to the South Seas, i, 273.) All these terms are the precise forms which the name of the largest of the Navigator Islands (*Savai'i*) would assume in the different dialects. It seemed probable, therefore, that by, following this clue, the different tribes of Polynesia might all be referred back to their original seat. On communicating these views to Mr. Williams, (but a few weeks before his lamented death,) he informed me that he had long entertained the opinion that the Samoan Islands were the source of the population of the other groups of Polynesia."

Mr. Hale's opinion, thus supported, was afterwards sustained by all the facts which his investigations brought to light, and also by incidental statements in the writings of former voyagers. He remarks upon one peculiarity of the Samoa group, that it is the only one in all Polynesia, in which the natives have a gen-

eral appellation for the group—the term *Samoa*. This word in Malay signifies *all;* in process of time it seems to have lost its meaning as an adjective and became a mere appellative; as we use the word *Union*, in speaking of the United States. The Samoan word for all, is *uma*, which means properly *finished, complete.* The changes which the word *Savaii* would undergo in the several dialects, are given as follows:—

"Original form, - - -	Savaiki.
Samoan dialect, - - -	Savai'i.
Tahitian, - - - -	Havai'i.
Sandwich Island, - - -	Hawai'i.
Rarotongan and Mangarevan, - -	Avaiki.
Nukuhivan, - - - -	Havaiki.
New Zealand, - - - -	Hawaiki."

Mr. Hale commences his review of the Pacific islands, with the *Society* group.

"As our attention was not drawn to this subject of investigation (that which connects the Polynesians with Savaii) until after we left this group, we are unable here to add any thing to what has been given by others. Fortunately this is amply sufficient for our purpose, and, as already remarked, has the great advantage of having been obtained and published without the possibility of a reference to any hypothesis like that now advanced. Mr. Ellis, in his Polynesian Researches (vol. ii, p. 234, American edition) says:—'*Opoa* is the most remarkable place in Raiatea; of its earth, according to some of their traditions, the first pair were made by *Tii* or *Taaroa*, and on its soil they fixed their abode. Here *Oro* held his court. It was called *Hawaii;* and as distant colonies are said to have proceeded from it, it was probably the place at which some of the first inhabitants of the South Sea Islands arrived.' As there is no *w* in the Tahitian language, (at least in the usual orthography,) it is here evidently written instead of a *v*. In another part of the same work, (vol. i, p. 105,) the author in treating of the origin of the Society Islanders, inclines to refer them to the Sandwich Islands, his principal reason being, that 'in some of their (the Tahitian) traditions, *Hawaii* is mentioned as the ancient name of *Opoa*, and *Oro*, who is by some described as both god and man, as having two bodies or forms, or being a kind of connecting link between gods and men, is described as the first king of Hawaii, or Opoa in Raiatea.' The Tahitian *v* is frequently sounded like *w*, and Mr. Ellis here evidently chooses the latter element, in order to show more clearly the resemblance, or rather identity, of the name, with the *Hawaii* of the Sandwich Islands. He was not at that time aware of the existence of a *Savaii* in the west;

had he been so, we may conclude that the reason which led him to derive the Society Islanders from the northern group would have induced him to refer both the Hawaiis to that source.

"Cook, in the history of his first voyage, (vol. iii, p. 69,) comparing the New Zealanders with the South Sea (i. e. Society) Islanders, observes that 'they both have a tradition that their ancestors, at a very remote period of time, came from another country; and according to the tradition of both, the name of that country is Heawije.' There is no *j* in either the New Zealand or Tahitian language. It may be a mistake, made in printing or copying, for *g*, the hard sound of which is frequently given by the Polynesians to their *k;* in this case *Heawije* would be the English orthography for the New Zealand word *Hawaiki.**

"But the most important testimony is that furnished by a chart drawn by *Tupaia*, (or *Tupaya*,) the native who accompanied Capt. Cook in his first voyage, and published by J. R. Forster, in his 'Observations made during a Voyage round the World.' It contains the names of all the islands known to Tupaia, either from having visited them, or by tradition. The extent of information displayed in it is truly surprising. We find every important group in Polynesia, except the Sandwich Islands and New Zealand, laid down, though not accurately, yet with a certain attention to bearings and distances, which enables us to identify them. What gives the chief value to the chart, is the fact, that, at the time it was drawn, more than half the islands which it contains were unknown to Europeans, and of those which had been discovered, the native names of very few were ascertained.

"Much confusion has been made in the chart by a mistake of those for whom Tupaia drew it. Knowing that *toerau* in Tahitian signified the north (or northwest) wind, and *toa* the south, they concluded naturally that *apatoerau* and *apatoa* were names applied to the corresponding points of the compass; whereas *apatoerau* signifies in fact, the point towards which the north wind blows, i. e. the south, and *apatoa* for the same reason the north. But not understanding this, they have, so far as these two points are concerned, reversed the chart completely, and it is in fact, printed upside down. But not content with this, it is apparent that these gentlemen (Capt. Cook, Mr. Banks, and Lieut. Pickersgill, whom Forster mentions as having obtained the chart) overlooked Tupaia while he was drawing, and suggested corrections, which his idea of their superior knowledge induced him to receive against his own convictions. This is clear, from the fact that all the groups and islands with which the English were not acquainted, are laid down rightly, according to the real meaning of *apatoerau* and *apatoa*, but

* The Polynesian letters *ai*, together, have the same sound nearly as *i* in *wine*.

wrong according to the meaning which those gentlemen ascribed to the words; while the islands whose position they knew, (the Marquesas and Paumotus,) are placed exactly as they should be, according to their mistaken meaning, but altogether out of the proper bearings when these are rightly understood. This, of course, makes great confusion, which can only be rectified when its origin is perceived.

"The westernmost group on this chart consists of eight islands, with compound names, all beginning or ending with *hitte*, as *Hitte-potto*, *Teamaroo-hitte*, &c. *Hitti* is the form which the Samoan word *Fiti* (*Feejee*) would take in Tahitian. One of these islands, *Ohiteroa*, answering to *Viti-levu*, has been removed from its proper place, as will be shown hereafter, by the same sort of correction as was applied to the Marquesas and Paumotu groups.

"To the east of this row of islets is another still larger, with the names *Weeha*, *Rotooma*, *Heavai*, *Ooporroo*, *Wouwou*, *Tootooerre*, and *Ouwhea*.* These are evidently *Uiha*, (one of the Habai cluster,) *Rotuma*, *Savaii*, *Upolu*, *Vavau*, *Tutuila* and *Uea*, (Wallis's Island.) The first and last from the similarity of names, seem to have become confused together; and Vavau is laid down out of its place,—but there is reason to believe that it was formerly considered as belonging politically to the Navigator group, to which it approaches nearest of any of the Friendly Islands. It should be observed that on many of the principal islands Tupaia made brief descriptive observations, which are given by Forster. *Heavai* is laid down five or six times the size of any other island, and Tupaia stated that it was larger than Tahiti, adding this remarkable observation,—'it is the father of all the islands.'

"Combining these various traditions, we shall probably be thought justified in supposing that the first settlers of the Society Islands came originally from the Samoan group, and landed or established themselves at the place now called *Opoa*, on Raiatea, which they named *Havaii* after the principal island of their native country. *Oro* (or more properly Koro) may have been their chief at the time of migration. Concerning the probable period at which this occurred, we shall offer some considerations in another place.

"Additional evidence that the earliest Tahitian traditions are of Samoan origin may be derived from the work of Mr. Moerenhout, (formerly American consul at Tahiti,) entitled, 'Voyages aux Iles du Grand Océan,' in which we find an ancient mythological code, obtained from

* These words are written by Cook according to English orthography, while those in the following sentence have the orthography which is now used in the Pacific. Uiha in Polynesian is pronounced *weeha*; Upolu, *oopoloo*, or *ooporroo* in different dialects; Uea, *oowea*; Vavau, *vahvow*.

an old Tahitian priest, which the author justly esteems of much importance. Its value is perhaps even greater than he supposed. It relates the creation of the world and of the inferior deities, as accomplished by Taaroa. The first part informs us that Taaroa existed from the beginning, and that he formed the world from his own substance. It concludes as follows:—

Mr. M.'s orthography.	*Native orthography.*	
Taaroa te paari	Taaroa te paari	Taaroa the wise
fanau fenoua hoaï;	fanau fenua Hawai'i	produced the land Hawaii,
hoaï noui raa	Hawai'i nui raa	Hawaii great and sacred,
éi paa no Taaroa	ei paa no Taaroa	as a shell (body) for Taaroa,
té oriori ra fenoua	tei oriori ra fenua	who created (or vivified) the world.

"That by *hoaïi*, Mr. Moerenhout means to spell (in the French orthography) *hawaii*, is evident from the fact that on page 558 of this volume, he requoted the passage which we have given above, and spells this word *ohaii*, and on page 221 of the second volume, he remarks, that *Ohaii* is the name of the largest of the Sandwich Islands, (*Hawaii.*) Mr. Moerenhout translates *ohaii* by *universe*, and it is likely enough that this may be the meaning now attached to it by the Tahitian priests. The second part of the ode continues the work of creation, and ends with the line '*épau fenoau no hoaïi*,' (or *e pau fenau no Hawaii*,) finished is the land of Hawaii. The third part relates the origin of the gods, who were born of Taaroa and his wives, after the creation of *ohaii*, and ends with '*tei moua iri té atoua Roo aravi na é éroto épou fanau ouporou*,' which should, perhaps, be, '*tei mua iri te atua Roo a rave na ei rotopu fanau Uporu*,' the god Roo remained in front and seeing that which was within, produced Uporu. This version is obscure and may not be altogether correct; but *fanau ouporou*, like *fanau fénoua hoaii*, can hardly be mistaken. Upolu is the second of the Samoan Islands, nearly equal in size and importance to Savaii. There can be little doubt that this is an ancient Polynesian mythos, relating to the supposed origin of the Navigator Islands, and that it was brought from thence by the first emigrants to Tahiti, where it has probably undergone only such alterations as the gradual change in the language rendered necessary.

Mr. Hale next takes up the Nukuhivan or Marquesas Islands; and shows both by tradition, customs and language, that they have a double origin, the northern cluster having been settled by natives from the Friendly Islands, and the southern, from Tahiti. He mentions the belief among the latter, first ascertained by Mr. Cook, "that the land composing their islands, was once located in *Havaiki* or regions below—the place of departed spirits—and

that they rose from thence through the efforts of a god beneath them." Commodore Porter heard from the Nukuhivans the tradition "that *Oataia* with his wife *Anamoona* came from Vavau eighty eight generations back, (reckoned in the family of Gattanewa himself,) and brought with them bread-fruit and sugar cane, and a great variety of other plants."

"Allowing for the present, the ordinary estimate of thirty years to a generation, it will give us two thousand six hundred and forty years since the arrival of Oataia from Vavau. It seems probable however that the first part of the royal genealogical list of Nukuhiva will be found like that of Hawaii, to be merely mythological; in which case the foregoing computation will require a corresponding correction, and the time elapsed since the settlement of the island will be considerably diminished."

The Sandwich Islands by a similar course of argument, are traced back through the Marquesas to Tahiti and Samoa. The word *Tahiti* means a *foreign country* in the Hawaiian language, and appears to point to some former knowledge of an island of that name, which was afterwards lost. Although ignorant of the Society Islands, "*Nukuhiva* and *Fatuhiva*, two of the Marquesas Islands are mentioned in their traditionary songs, as among the places visited by voyagers from Hawaii in former days." The Sandwich Islands are nearly 2000 miles from the Marquesas, on the other side of the equator; yet this long journey must have been performed by these savages; and moreover they carried with them dogs and pigs, as is evident from their traditions, and also from the breed of these animals being the same as in the other groups. The word Hawaii, given to one of their islands, is the Savaii of Samoa, an island of similar character in features and size.

The Hawaiians reckon up *sixty seven generations* since the migration from the Marquesas took place, and this genealogy forms a kind of verse, in triplets, the father, wife and son, (afterwards his successor) in each line.

"It might be doubted whether the natives could remember with accuracy so far back; but this doubt would cease on hearing one of them recite the genealogy in question. As given in the native history, called the Moo-olelo, it stands as follows,—beginning with the second king, the son of Watea and *Hoohotutalani*.

Husband.	Wife.	Child.
O Haloa.	Hinamanouluae.	O Waia.
O Waia.	Huhune.	O Hinanalo.
O Hinanalo.	Haunuu.	O Nanatehili, &c.

"But in the native recitation, as we have heard it, the words *tane* husband, *wahine* wife, and *tamaiti* child, are introduced after each name in the respective columns, thus—

O Haloa te tane,	O Hinamanouluae ta wahine,	O Waia te tamaiti.
O Waia te tane,	O Huhune ta wahine,	O Hinanalo te tamaiti, &c.

This, it will be seen, makes of it a species of verse, with, in fact, a greater approach to rhythm than most of the native poems. Accordingly the recitation is made in a kind of chant, to a regular tune, and any person who can retain in his memory a song of a hundred lines can have no difficulty in remembering this genealogy."

"It is to be observed that this is not, properly speaking, a list of kings, but merely of generations. In most cases, which frequently happened when two or more brothers succeeded one another on the throne, their names are given in the column of children. Thus *Liloa*, the eleventh in a direct line before Tamehameha, had two sons, *Hatau* and *Umi*, of whom the first succeeded him, but was deposed for his tyranny, and the kingdom transferred to Umi. Both of these names with those of their respective mothers are given in the genealogy, but the former only among the children." "This explanation is necessary because the number of years to be allowed to a generation will be at least double that which we should assign to a reign." "Allowing thirty years to a generation, and supposing the list to be a correct one, we should have for the time that has elapsed since the settlement of the Sandwich Islands, about *two thousand* years.

But Mr. Hale goes on to state—

"Though there is no doubt of the ability of the natives to preserve a genealogy of this length, several circumstances incline us to question its entire correctness, and to doubt whether the first 23 names be not entirely supposititious. In the first place, the name of the king at the head of the list, O Watea, is precisely the same in pronunciation, with the Oataia of the Marquesans, (the orthography only being different.) The name of his wife is Papa, of whom it is said, 'she was the mother of all the islands.' This is the same name and the same tradition that the Tahitians apply to the wife of their great deity, Taaroa. It is further related by the Hawaiians that Watea and Papa had a deformed child, whom they buried, and from it sprang the *taro*-plant; the stalk of this plant was called *haloa*, and this name was

given to their son and heir who suceeded them. This fable is evidently derived from the Nukuhivan story that the children of Oataia were named after the various plants which he brought with him from Vavau. Thus we have, in the commencement of the Hawaiian history, a singular mixture of Marquesan and Tahitian traditions. The twenty second king was *Atalana*, being the name of the god who supports the island of Savaii. He had four children, all of whom were named *Maui*, with some epithet appropriated, in other groups, to a deity. The youngest, *Maui-atalana*, succeeded him, and to him are attributed the same deeds that the Tahitians relate of their great deity *Maui*,—another name or manifestation of Taaroa. He was succeeded by Nanamaoa, from whom the real history of the islands seems to commence.

"The probability is that the Sandwich Islands were first peopled by emigrants from the Marquesans, of the mixed race which is there found. When, after a time, the inhabitants had become numerous, and some family was raised to supreme power, it became an object to trace the pedigree of the sovereign as far back as possible. After ascending as far back as their recollections would carry them—perhaps to one of the first settlers—till they reached an ancestor whose paternity was unknown, they made him, according to the usual fashion in such cases, the son of a god, *Maui*. This god was represented as the son of another deity, Atalana, and not satisfied with this, they added on as many names as they could recollect of the genealogy of the Marquesan kings, mixed with Tahitian deities and personified qualities. Thus the first name is, as above stated, the Nukuhivan *Watea;* the fourth is *Hinanalo*, a word which means *desire* in all the dialects except the Hawaiian; the tenth is *Manatu*, which means *memory* in the Samoan and Tongan languages; the eleventh is *Tahito* or *ancient;* the twelfth and thirteenth are *Luanuu* and *Tii*, two of the principal deities of Tahiti, belonging to the class which they term *hanau-po*, 'born of night.' Moreover, the wives of the first five kings are said not to have been different persons, 'but only different names of *Papa*, as her soul inhabited sundry bodies by transmigration,' which sufficiently shows that this part of the genealogy was looked upon as merely mythological.

"If this opinion be thought correct, it will be necessary to deduct twenty two generations from the list, (one of the twenty three kings having been a brother of the preceding,) which will leave for the whole number forty five. Multiplying this by thirty, we have thirteen hundred and fifty years from the commencement of the Hawaiian records, (and perhaps from the settlement of the country, though that is uncertain,) to the succession of Tamehameha; or reckoning to the present date, about fourteen centuries."

Farther confirmation of the origin of the natives from the Marquesas is drawn from some peculiarities of language; for example, "the Marquesas and Hawaiian are the only dialects which use the proposition *ma* before the locative adverbs;" "as a plural sign to denote a company or party the Tahitian has *pue;* the Nukuhivan (or Tahuatan) changes it to *poe*, like the Hawaiian," &c.

The *Rarotongans* or *Hervey Islands*, as well as the natives of Aitutaki consider *Avaiki* [Savaii] to be the country *beneath*, from which the first man, *Mumuki*, ascended to look for food. Throughout the Pacific, as Mr. Hale states, the same word means leeward, westward and below. A similar use of the words up and down with reference to opposite points of the compass is common to most, if not all languages. The trade winds at the Hervey Islands blow usually from the southeast, and Savaii which lies to the northwest is therefore nearly as possible "below" them. The traditions of the islanders refer their origin to two canoes of natives, one from an island to the westward called *Manuka* (the name of one of the Samoan islands) and the other from *Tahiti;* and the opposite sides of the island which they settled bear to this day the name of the leader in each, the former being called after Karika, Ngati-Karika, and the latter after their chief Tangiia Ngati-Tangiia. Moreover the Tahitians have traditions of Tangiia as a great navigator. We only glance here at Mr. Hale's arguments, and pass on to the

Gambier or Mangareva group, situated about a thousand miles to the eastward of the Society Islands.

"In the manuscript vocabulary of the Mangarevan dialect, which I owe to the kindness of M. Maigret, formerly missionary to this group, is found the following definition: '*Avaiki*, bas, en bas; *ko runga tenei, ko avaiki tena*,—ceci est le haut, cela est le bas.' From this it would appear that Avaiki, which in the Hervey Islands, is used to signify the region beneath, has come to denote, in the Gambier group, simply *below*, or *that which is below*. Examples of similar changes are not uncommon in the other dialects. At the Navigator group the wind which blows from the direction of the Tonga Islands (i. e. from the south) is called the *Tonga* wind. At the Hervey and Society Islands, this same word (*tonga* and *toa*) is used as the general term for south wind.

"A genealogy of the kings of Mangareva, drawn up by a native pupil of M. Maigret, with a few of the traditions respecting them, offers some points of considerable interest. The number of kings

whose names are given is twenty seven. The first was *Teatumoana*, a name which means 'Lord of the Sea.' From him, the history says, 'all the inhabitants of the land are descended. He had no father, or perhaps he was a foreigner.' From him the line continues unbroken till the ninth king, *Anua;* he was succeeded by his son-in-law, *Toronga*, the name of whose father was not known. He was not, it appears, acknowledged by many of the chiefs, and a civil war ensued. One of the principal rebels named *Uma* was worsted, and, it is said, 'took refuge on the sea, and fled to a foreign land.' Afterward Toronga was killed by another chief, who endeavored to obtain his body in order to eat it; but the son of the murdered king secreted his father's corpse and buried it. The name of the son and grandson of Toronga are given, but their reigns must have been very short—perhaps merely nominal—for one of the chief combatants in the civil war succeeded finally in gaining the supreme power. His name was *Koa*, the thirteenth on the list, and from him the reigning sovereign derives his authority. His principal opponent, *Tapau*, fled to a foreign land, or abroad. After this follows an account of the numerous dissensions which took place in the different reigns, and the annalist remarks, 'formerly they fought much; formerly they ate each other.' The twenty second king, *Temangai*, was deposed and obliged to flee abroad. The usurper *Teitiou* succeeded, 'but his reign was short; he was conquered suddenly.' His name, it should be remarked, does not appear in the list—which shows, with several other circumstances, that it is in fact a genealogy, and not a complete enumeration of all who have held the sovereign power. The present king, *Maputeva*, is the fourteenth in a direct line from *Koa*, who gained the supremacy after the death of Toronga, the son-in-law of Anua, the eighth in descent from Teatumoana. The son and grandson of Toronga may be omitted, in which case it will appear that twenty five generations, or seven hundred and fifty years, have elapsed since the arrival of the first colonists. Therefore, if we suppose, as all the circumstances indicate, that they came from *Rarotonga*, they must have left that island about four generations, or one hundred and twenty years, after it was settled. This would account for some of the peculiarities in the dialects of Mangareva. The only points of any importance in which it differs from the Rarotongan are, first, in the use of *raŋa* instead of *aŋa*, to form the participial noun, as *te ope raŋa* for *te ope aŋa*, the act of finishing; and secondly in the use of *mau* as a plural prefix. In both these points it resembles the Tahitian. Now if the Rarotongan emigrants who settled in Mangareva, came, as is most probable, from that side of Rarotonga which faces toward the latter group, (i. e. the eastern side,) they were of Ngati-

Tangiia, or Tahitian party, and may at that time, have preserved some peculiarities of their original tongue which were afterward lost in Rarotonga, on a more complete intermixture wiih the *Ngati-Karika*, or Samoan party.

"In the foregoing traditions, the existence of cannibalism at a very early period will be noticed, as also the custom with conquered chiefs, of betaking themselves to the open sea to escape the vengeance of their adversaries. It was in this manner that *Temoe* or Crescent Island, a coral islet which lies about thirty miles to the southeast of the Gambier group, was peopled between sixty and seventy years ago. A defeated party fleeing from Mangareva, were drifted to this island, and remained there with their descendants, till the arrival of the Catholic missionaries, who, hearing of their situation, sent for them and restored them to their original homes. This well authenticated fact shows the manner in which most of the South Sea Islands have probably received their first inhabitants."

We have followed Mr. Hale sufficiently far to show the character of his argument, and shall but briefly notice the remaining pages. At the Paumotus, there is the same evidence with regard to the origin of the present inhabitants. Yet he remarks that they have an element in their language which indicates a commingling with some different race. At New Zealand, it is the traditionary belief that the first nations came from *Havaiki*, a country to the east, and the names of the canoes and first emigrants are retained by them. From the variations in the dialect from the original type, it is inferred approximatively that the settlement of New Zealand took place nearly at the same time with Tahiti, or probably not less than 3000 years ago. The names for the months in different dialects, for the winds, and for numerals, affords confirmation of the general conclusions adduced. With regard to the Tonga Islands, he finds reason for tracing them direct from the East Indies through the Feejee group, and attributes some of the characteristics of the Feejee natives to a partial mixture of Malaisian with the original Papuan of those islands. Much that is interesting on this point might be cited.

The Kingsmill or Tarawan Islands, both by tradition and language are connected with the Samoan on one side and with Banabe, one of the Philippine Islands on the other.

These various conclusions are laid down on the chart, (a reduction of Mr. Hale's,) which accompanies this article. All the various groups are seen to trace their origin more or less directly to the Samoan or Tonga Islands.

But the question comes up, may the Polynesians be traced any farther back in their history? The following paragraphs from the close of the discussion, offer at least a probable conjecture.

"That the Polynesians belong to the same race as that which peoples the East Indian Islands is, at present, universally admitted. If any doubt had remained on this point, the labors of Wm. Von Humboldt and Prof. Buschman, would have been sufficient to set it at rest. Having traced all the principal tribes of Polynesia back to the Samoan and Tongan groups, it next becomes a question of interest, how far the information which we now possess will enable us to verify the supposed emigration of the first settlers in these groups from some point in the Malaisian Archipelago. From the almost total ignorance in which we yet remain of the dialect spoken in the eastern part of this archipelago, our means of forming a judgment are very limited. Nevertheless we may venture to offer a conjecture, based upon such an amount of evidence as may seem to bring it at least within the bounds of probability.

"The nations of Tonga and Samoa as has been before stated, refer the origin of their race to a large island, situated to the northwest, called by the former *Bulótu*, by the latter *Pulótu* and *Purótu*. As the *l* and *r* are used indifferently in these dialects, it would be doubtful which was the proper spelling; but the Feejeans, who distinguished between these two elements, have borrowed this and many other traditions from their eastern neighbors, and call the island in question *Mburótu*. Hence we may conclude that *Burótu* or *Purótu* is the correct form. Now the easternmost island inhabited by the yellow Malaisian race, in the East Indian Archipelago, is that called on our maps *Bouro* or Booro. It lies west of Ceram, which is occupied in the interior by Papuans and on the coast by Malays. Apart, therefore, from any resemblance of name, if we derive the Polynesians from that one of the Malaisian islands which lies nearest to them, we should refer them to the above mentioned Bouro."

After some additional facts and observations on this subject, Mr. Hale concludes by suggesting that the syllable *tu* may have the force of "sacred" or "divine."

"It must be recollected that the natives of Samoa and Tonga, look upon this island not only as the country of their progenitors, but also as the residence of their gods. The syllable *tu* is perhaps that which is found in the Samoan *aitu*, spirit, and the *otúa*, *atúa*, *etúa*, which in the different Polynesian dialects, signify divinity. *Tuan* is the word for 'lord' in Malay, and *hautu* for 'spirit' in Malay, Javanese, and Bugis."

ART. II.—*On Three several Hurricanes of the American Seas and their relations to the Northers, so called, of the Gulf of Mexico and the Bay of Honduras, with Charts illustrating the same;* by W. C. REDFIELD.

(Continued from p. 169.)

Hurricane of the Honduras Sea, Cuba, and the Western Atlantic, in October, 1844.

This remarkable storm, which I designate as the *Cuba Hurricane*, came from the direction of the Pacific Ocean and the regions of Central America. It appears to have entered upon the bay or sea of Honduras, which is the western arm of the Caribbean sea, directly from the countries of Honduras, Poyais and Yucatan, on the 3d and 4th of October. From the Honduras sea it passed over the island of Cuba, the southern part of Florida, and the Bahama Islands, and continued in a northeasterly course, to the Gulf of St. Lawrence and the island of Newfoundland, with a rapidity of progress hitherto unknown in American storms. It swept, in its progress, the salient portions of the North American continent on the one hand, and the eastern parts of Cuba and Newfoundland, together with Bermuda, on the other; while its pathway exhibited an amount of injury and destruction such as is rarely known in the annals of commerce.

PRECURSORY STORM. On the 1st and 2d days of October, Cuba was visited with stormy weather, attended by an extensive and unusual fall of the barometer; and this depression of the barometer was mainly or partially continued after the gale had ceased, the weather remaining unsettled. I cannot trace, otherwise than barometrically, the progress of this prelusive storm on its departure from Cuba, except at Key West, and again in the higher latitudes; as will be seen hereafter. It was included, evidently, in a vast gyrative influence which comprised both storms; while the principal or most active vortex was developed in the subsequent hurricane. It will be found that the barometric depression of this earlier storm, continued to advance along the whole Atlantic coast of the United States, and over a wide extent of adjacent country. The probable influence of this advanced diminution of pressure, on the course and progression of the hurricane which followed, may be hereafter considered.

PRELIMINARY STATEMENTS. A violent thunder-storm, attended with heavy rains, visited Barbadoes and other windward islands, on or about the 25th of September; but, so far as I can learn, this atmospheric disturbance did not move down the Caribbean sea. On the contrary the weather was fine on the coast of Columbia, for the last ten days of September and the first week in October, with light westerly winds.*

A 'norther' of moderate force visited the eastern borders of Mexico during the latter days of September, of which I have found subsequent traces in the basin of the Mississippi. At Tampico and Vera Cruz two northers appeared between the 21st of September and the 1st of October, followed, at Vera Cruz and the southern part of the Gulf of Mexico, by a norther which was cotemporaneous and perhaps connected with the Cuba storm, prelusory to the great hurricane. An abridged extract from the logbook of the U. S. steamer *Union*, in the early part of October, from off Velasco to Pensacola, is given below, and her track will be found on chart IV, which illustrates this storm.† See also the abridged log of the R. M. steamer *Trent*.

Various accounts have been obtained from the tract of ocean lying east of the storm's path, by means of marine reports, vessels spoken, logbooks, &c.; and the positions of some vessels are

* Statements of shipmasters from that coast.

† U. S. steamer *Union*, Lieut. McBLAIR, at anchor off Velasco, Sept. 26th; P. M. fresh breeze from N. E. and squally; wind increasing with rain;—27th, increasing from southeastward till 8 A. M.; moderating till noon. Velasco W. by N. 6 miles. P. M. winds light and variable; from 4 P. M. fresh gales from northward and cloudy. Sept. 28th, A. M. fresh gales from northward with rain; P. M. fresh from northward and N. W. and cloudy, with a high sea. Sept. 29th, A. M. moderating and sea going down. Lat. obs. 28° 50′; P. M. at sea, moderate breeze from N. E. and pleasant. Sept. 30th, lat. 27° 48′, lon. (chr.) 94° 43′, moderate breeze E. N. E.; ends squally from N. E. Oct. 1st, moderate winds E. N. E. and pleasant; lat. 27° 53′, lon. 94° 15′, P. M. fresh breezes from N. E. by E., and E., pleasant. Oct. 2d, moderate and light winds E. N. E. and pleasant; lat. 28° 46′, lon. 94° 38′; P. M. same. Oct. 3d, light winds from N. E. and pleasant weather; lat. 28° 32′, lon. 94° 11′; P. M. light wind from N. and pleasant. Oct. 4th, moderate from N. E., clear and pleasant; 8 A. M. to noon fresh, N. N. E. and pleasant; lat. 27° 57′, lon. 92° 51′; P. M. moderate breeze from N. E. Oct. 5th, wind from N. E.; from 8 A. M. *a heavy swell from northeastward;* lat. 27° 22′, lon. 91° 30′; P. M. light winds from northward and pleasant. Oct. 6th, light winds N. W., N. and S. W. and pleasant; lat. 27° 50′, lon. 89° 40′; till 4 P. M. N. W. light and pleasant; evening, squally. Morning of 7th, N. W. pleasant; noon of 7th, lat. 28° 31′, lon. 87° 13′. [For a further account of the Northers on the coast of Mexico, near the close of September, see the report from R. M. steamer *Trent* in the recitals, case 2*c*.]

marked on the chart. But we have no evidence of the prevalence of a storm in this region at that period, other than appears in our recitals.

The accounts now to be exhibited will serve to determine the route, character, extent, and progression of this memorable hurricane, and of the barometric depression and the expanded storm which preceded it. The principal facts which these accounts afford, have been first duly noted geographically, upon a large marine chart; in process of which it became apparent that the chief violence of the gale was exhibited along the more central portions of the track. It was found, also, that a direct line drawn from the island of Ruatan, on the coast of Honduras, in the direction of N. 40° E., crossing Cuba, Sable Island and Newfoundland, would bisect the area of violence throughout this distance. It likewise appeared, on farther inspection, that by changing this line to one slightly curved, by bending its central portion slightly towards Cape Hatteras and its extremities in the opposite direction, it would be found to divide very nearly, that portion of the track in which the winds set in from the southeastern quarter and veered by the *south* to the westward, from that other portion of the storm's path in which its winds commenced from the eastern or northeastern quarter and veered by the *north* to the northwestern quarter. This line is therefore adopted on the annexed chart, (chart IV,) as indicating, with approximate accuracy, the route pursued by the axis of the gale, and will be called the *axis line.*

This axis line is supposed to intersect the 20th parallel of latitude near lon. 83°,—crosses Cuba to the eastward of Matanzas, passes near Orange Key,—near the west point of Abaco,—intersects parallel 30° near lon. 75° 15′,—par. 40° near lon. 65°,—par. 45° near lon. 58° 30′, and par. 50° near lon. 50° 40′. Lines are also drawn at the distance of sixty miles on each side of the axis line, as approximating a center path of one hundred and twenty miles in width; also at distances of two hundred and four hundred miles, on each side of the axis line, for the general purposes of reference, in scanning the observations. The supposed distances of the several vessels, or places of observation, from the axis of the gale, when nearest the same, will be stated in miles, sixty nine to a degree of the meridian,—with the initials, R. if to the right, and L. if to the left of the axis line.

Our limits do not allow the printing of the several logs and meteorological reports at full length and in their tabular forms;

but in the necessary abridgments of these, and of written statements received from shipmasters, I have endeavored faithfully to exhibit all that can serve to afford us any knowledge of the strength, extent and progress of the storm, and of the time and manner in which its winds were successively exhibited.

I will first submit such accounts of the storm as relate to the left hand side of the axis line, as far onward, in its course, as the south shore of Cuba, and including the adjacent portions of the Gulf of Mexico.

1. At Belize, British Honduras, lat. 17° 29′, lon. 88° 12′, [180 miles L. ?] the weather in the first week in October, as stated by the master of the *Gilbert Hatfield*, "was very bad;" with squalls and heavy rains; "very wild weather." The mate thinks the worst of the weather was between the 1st and 4th of October. [This position was in the Belize river, near the southeastern shore of the peninsula of Yucatan, and under the immediate shelter of the broadest if not the most elevated portion of Central America.]*

Mr. LONSWORTH, pilot at Belize, informed Capt. GOOD that the effects of the gale were experienced on all the Honduras coast. Capt. REED was informed at Belize, that the gale was heavy outside, and that several vessels drove from the anchorage.

2*a*. Logbook of brig *Maria L. Hill*, at anchor off Campeche, lat. 19° 51′, lon. 90° 33′, [380 miles L. ?] "Oct. 2d, pleasant. Oct. 3d, strong Norther this day; received no cargo. Friday, 4th, strong Norther all this twenty-four hours; received no cargo. Oct. 5th, more moderate; wind still to the north."—From this time the weather continued pleasant till the 13th. [This appears to show us the left border of the gale.]

2*b*. At Grand Suline, (Bouche de Silan,) N. coast of Yucatan, lat. 21° 25′, lon. 88° 42′, [360 miles L.,] the *Betsey Hall*, loaded with mahogany and ready for sea, went on shore Oct. 4th, during a heavy swell and imbedded in the sand. The *Alexander Petron* and *Artebonite* also dragged their anchors and went on shore; the former knocked her bottom out and sunk.—(*Shipping Lists.*)

2*c*. Royal Mail steamer *Trent*, at anchor off Tampico, took a Norther on the night of Sept. 21st, and was compelled to slip cables and proceed to sea; continued blowing from N. N. W. till 24th, with barometer from 29·80 to 29·82. Returned to the anchorage and had strong breezes between S. E. and E. N. E. till 27th, when the wind hauled to N. N. E. At 4 A. M. of the 28th, a violent northerly gale set in, with no indication beyond the rising of the barometer, which compelled us to slip a second time, blowing from N. N. W., with a heavy sea, through the 29th, and continued with strong breezes on the 30th,—and fresh breezes Oct. 1st, with fine weather; the barometer ranging throughout the Norther, from 30 in. to 30·14; thermometer from 82° to 78° Fahr.

Oct. 2d, fresh breezes with dark blue clouds to the N. W.; at 8 A. M. anchored at Vera Cruz; bar. 30·15, wind increasing; noon, strong breezes, bar. 30·12; 4 P. M. fresh gales from N. N. W.; 6 P. M. proceeded to sea; 8 P. M. bar. 30·07, therm. 82°; midnight, heavy gales with much sea. Oct. 3d. A. M. fresh breezes from N. N. W., with thick rain and much sea; 8 A. M. bar. 30·02; noon, 30·00, lat. 20° 7′, lon. 94° 29′; 8 P. M. bar. 29·98, range of therm. 85° to 84°; towards midnight heavy gales from N. W. Oct. 4th, strong gales this day from N. to N. N. W. with heavy sea from northward, the bar. fell in half an hour from 29·98 to 29·90; 8 A. M. bar. 29·90; noon, bar. 29·92, lat. 20° 14′, lon. 92° 40′, *the swell became very high and came from N. E.*; [then 540 miles L. ?] weather hazy and sky of a copper-colored appearance, *small scud flying fast*; 8 P. M. bar. 29·92; therm. 84° to 83°. Oct. 5th, strong breezes and squally this day, from N. N. W. to N.; 8 A. M. bar. 30·02; noon, 30·02, lat. 21° 53′, lon. 90° 17′, [468 miles L. (?)] therm. 84° to 82°, atmosphere still hazy,

* The profile elevation of this part of Central America, above the two oceans, is believed to be about five thousand feet. But both eastward, and westward, near the Lake of Nicaragua, and at the isthmus of Tehuantepec, the elevation is inconsiderable, say five hundred feet.

air cooler to the sense, heavenly bodies much clearer. Oct. 6th, moderate breezes from N. by W. and fine, atmosphere clear and dry, bar. 30·02 to 30·05, lat. 22° 31′, lon. 87°, therm. 83° to 82°.—[Abridged from journal of J. F. BOXER, R. N., Commander, received from Col. REID, February, 1846.]

[From the time of reaching Vera Cruz, this steamer appears to have experienced bad weather almost simultaneously with that which visited Jamaica and the S. side of Cuba, which remitted on the 3d; and on the 4th, this vessel evidently had begun to encounter the swell and blow pertaining to the Cuba hurricane, which abated on the 5th.]

3. Ship *Clyde*, laden with mahogany, left Omoa, [south part of the bay of Honduras, lat. 15° 45′, lon. 88°,] and has not been heard of; but part of her cargo was found, after the gale, near the Northern Triangles, lat. 18° 40′, lon. 87° 15′, [170 miles L.]

The brig *Florida Banca*, which, as we have seen, encountered the two previous hurricanes, left Belize Oct. 1st, and has never been heard from since that date.

4. Ship *Gossypium*, from Liverpool for New Orleans, on the 4th and 5th Oct., lat. 20° 30′, lon. 85°, [130 miles L.,] experienced a hurricane, with the wind veering round the compass; on 5th lost fore and main masts and sprung the rudder. Oct. 7th, spoke a brig from Jamaica which had lost spars and sails in the hurricane. [The phrase "round the compass," is used somewhat vaguely by seamen. This ship being in the left center of the gale, probably had the same succession of winds as the *Angola* and *Openango*. (Nos. 6 and 7.)]

5. Brig *Majestic*; Friday, Oct. 4th, commences with heavy weather blowing from E. S. E. At noon both masts went over the side, carrying with them bulwarks, &c. At 1 P. M. shipped a heavy sea, which washed away quarter bulwarks, with the captain and one seaman; at 3 P. M. a little moderate; at 4 P. M. increased in a hurricane from N. W. At 8 A. M. of the 5th, blowing a moderate gale from W. N. W.; made sail, on jury-masts, for Jamaica or Grand Cayman; lat. at noon by obs. 20° 15′, lon. 82° 45′. [Probable position on the 4th when the gale shifted, lat. 20° 30′, lon. 83° 10′, or 30 miles left of axis line; the brig having been afterwards driven with a N. W. gale, and being on or near the axis line at noon of the 5th.]

6. Brig *Angola* was dismasted in the hurricane, about 50 miles off the west part of the Isle of Pines, [(?) lat. 20° 45′, lon. 83° 40′, 69 miles L., ?] on the night of Oct. 4th. At 8 A. M. of the 4th, the gale had become so violent that the brig was hove to, and so continued till dismasted, the wind from E. N. E., veering to N. N. E.; was heaviest from 6 to 11 P. M., and continued to veer from N. N. E. to N. W., after which it began to moderate. The brig's barometer in the gale, was observed at 29 inches.

7. Brig *Openango*, from Jamaica; on the morning of Oct. 4th, it commenced blowing from the eastward and increased during the day, hauling to the northward. Had the heaviest of the hurricane from N. N. E. to N. N. W., between the hours of 5 and 10 P. M. of the 4th, lat. 21° 15′, lon. 83° 30′, [74 miles L.] It continued blowing during the night and veering to the N. W., gradually abating. Lost spars, sprung a leak, &c. When it moderated the brig was judged to be in lat. 20°, lon. 82° 30′.

8. Ship *Hermann*, for New Orleans, was dismasted in the hurricane, Oct. 4th, on the S. side of Cuba. On the 5th, saw a brig 150 miles from the land, totally dismasted, [(?) lat. 19° 50′, lon. 84°. ?]

9. Ship *Elizabeth*, encountered the storm on the night of Oct. 4th, the wind blowing a terrible gale from the westward.(?)* On the 5th, the gale increased to a hurricane, and shortly the main and mizen-masts were carried overboard by its violence. In the succeeding night it was found that the ship had sprung a leak; all took to the boats, and the ship soon went down. The boats then *pulled to the westward* in a heavy sea; one boat reached Sisal on the coast of Campeche, in six days; another was picked up by a brig bound to Vera Cruz; the third, containing the officers and most of the passengers, was never heard of. [This account seems to show that the ship was near the W. end of Cuba, in the Yucatan channel or the adjacent borders of the Gulf of Mexico.]

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* The true solution of this, probably is, that the wind was blowing from the westward at the time when the ship was dismasted; unless we assume the word "westward" to be an error. The report evidently is from the suffering seamen who survived.

10. Ship *Dantzig*, for Havana, was spoken on the 11th in lat. 23° 30′, lon. 86° 30′, having been dismasted in the hurricane *on the 4th October*. [Must have met the hurricane on the south side, or off the west end of Cuba.]

11. Barque *Franklin*, Oct. 4th, off the west end of Cuba, experienced a tremendous hurricane; [(?) 235 miles L. ?] lay to 17 hours under bare poles, part of the time on her beam ends, expecting the masts to be blown out of her; suffered much damage, *and was driven 100 miles to the S. W.* With calms and currents, took 14 days to gain her former position. [This shows clearly the general direction of the gale off the W. end of Cuba.]

12. Schr. *H. Plantagenet*, for Havana, encountered the hurricane in the Gulf of Mexico about forty miles from Tortugas, the wind blowing strong from N. N. E. [(?) 230 miles L.] Was compelled to throw over part of the cargo, but suffered no other damage.

We now pass from the left to the right side of the storm.

13. Brig *Trojan*, from Kingston, S. side of Jamaica, sailed Oct. 2d, and took the hurricane off the Grand Cayman, blowing from S. S. E. From the 1st of Oct. clouds had been flying thick and fast from the southward; the weather in the western quarter looking dark and threatening. Oct. 3d, the barometer had fallen, and it continued to fall till 8 P. M. of the 4th. Morning of the 4th, strong breezes from S. E.; at 9 A. M. had commenced blowing hard from S. S. E. During the day and evening the gale veered from S. S. E. to S. S. W., from which last point, about 9 P. M., was the worst of the gale. [Then about 145 miles R.] At 10 P. M. the barometer had sensibly risen, the wind settling at S. W. as the gale abated.

14. On a subsequent date, Capt. DAVIS, in the *Trojan*, spoke the brig *Homer*, which had sailed from Kingston *two days before him*, for Laguna, on the S. coast of the Gulf of Mexico, and had been totally dismasted on the 4th of Oct. [The *Homer* was probably in the heart of the gale.]

15. Brig *Eastern Star*, at Falmouth, Jamaica, [N. side,] Sept. 30th, fine weather; at half past 9 P. M. a heavy squall of rain. Oct. 1st, fine, with land breeze through the day; at 2 P. M. sailed for Black river, [S. side of Jamaica;] wind southward. At 7 P. M. was off Montego Bay; at 8 P. M. took in top gt. sails; fresh breezes from S. S. W. with squalls; at midnight, reefed. Oct. 2d, at 2 A. M. took in mailsail and jib; [first gale, which appears to have been more severe in Cuba;] at 8 A. M. shook out reefs; set the mainsail. At noon, the W. end of Jamaica bore S. S. W.; P. M. fine weather and head sea, wind S. E. by S.; fine breezes; at midnight, Cape Negril bore E. by S.

Oct. 3d, winds S. E. to S. S. E. with squalls and rain; at 4 P. M. blowing a heavy tempest; at 6 P. M. Cape Negril, S. point, bore E. S. E. [This cape is in lat. 18° 15′, lon. 78° 25′, 305 miles R.] At night, strong gales with heavy squalls. Oct. 4th, gale continues; at 9 A. M. bore up to make a harbor; at 11 A. M. ran into Orange Bay; [315 miles R.;] at noon, parted the best bower; P. M. and night strong gale and heavy squalls from S. S. E. with rain, thunder and lightning. Oct. 5th, at 4 A. M. parted the small bower and went to sea; bore up for the N. side, wind S. S. E. with squalls; at noon was off Falmouth. The wind veered during this day from S. S. E. to S. W.; fresh breezes and squally weather. Oct. 6th, calms and squalls.*

16. Capt. RAY, of brig *Com. Hull*, states that there was no blow at Falmouth, Ja.,; but on the night of the 4th and day following, a heavy sea hove in from the northwestward. [Lat. 18° 28′, lon. 77° 41′, 345 miles R., and under the shelter of the mountains or highlands of Jamaica, the wind being southward.]

17. At Montego Bay, Ja., [lat 18° 28′, lon. 77° 57′, 330 miles R., and under like shelter as Falmouth,] Oct. 4th, after threatening weather it commenced blowing hard from S. between 9 and 10 P. M. A strong ground swell had heaved into the bay from about 3 P. M., and before 2 A. M. of the 5th, it had acquired a terrific force. During the 5th there was

* Perhaps the early appearance of the second storm or hurricane at Jamaica, indicates for it a more eastern origin than would be apparent from a mere inspection of Chart IV. There seems, however, to have been but little separation in the two storms in the latitude of Jamaica.

comparatively little wind, but the sea raged in the most dreadful manner.* This swell occasioned the loss of twenty one vessels in the bay, chiefly droggers and other small craft.

18. At St. Jago de Cuba the gale of Oct. passed over without any damage, as stated by Capt. CROWELL, of the *Curlew*. [St. Jago is on the S. side of Cuba, lat. 20°, lon. 76° 7′, 365 miles R.; is N. E. from the center of Jamaica and more exposed than the latter to the storm from off the Caribbean Sea; but the harbor is sheltered.]

19. Ship *Norman*, for New Orleans, Oct. 1st, course W. by S., 4 to 7 knots, thick squally weather with showers of rain. No obs.; [lat. D. R. 18° 54′, lon. 75° 05′;] P. M. wind S. S. E. courses N. W. to W. S. W., 8 to 9 knots. Oct. 2d, strong gales from S. E. and thick cloudy weather; running down the island of Jamaica. No obs.; [lat. D. R. 18° 51′, lon. 77° 15′;] P. M. strong winds from S. and squally; at 6 P. M. S. end of Jamaica bore S. S. W. 30 miles. Through the night strong gales and thick blowing weather. Oct. 3d, at 3 A. M. double reefed the three topsails; [latter part of the precursory gale;] at 10 A. M. more moderate; set main-topsail and top gt. sail; no obs.; [lat. D. R. 18° 54′, lon. 80° 10′, 200 miles R.;] P. M. had strong gales from S. E. and S. S. E. and thick cloudy weather. Course W. by S. and W. S. W.; at 11 P. M. gale increasing.

Oct. 4th, at midnight double reefed topsails and furled mainsail, gale increasing; 2 A. M. wind S. S. E.; 4 A. M. took in jib and spanker; 6 A. M. close reefed the three topsails, furled fore-sail and mizen-topsail; at 7 A. M. gale increasing to a hurricane, furled the fore-topsail; at 9 A. M. hove the ship to with her head to westward, under close-reefed main-topsail and fore-topmast-staysail; wind S.; set balance-reefed spanker and mizen-staystail; hurricane increasing. Noon, lat. by bad obs. 19° 06′, [lon. D. R. 81° 40′, 140 miles R.] P. M. blowing a tremendous gale from S. which continued throughout the night with heavy gusts of rain; ship laboring heavy and masts in great danger. Oct. 5th, at 6 A. M. wind had veered to S. W., wore ship to S. E.; at 8 A. M. the gale abated a little; set close reefed fore-topsail. Lat. obs. at noon 19° 57′, [lon. D. R. 81° 28′.] P. M. blowing a heavy gale from W. S. W. and a heavy sea; set close-reefed mizen-topsail. At 11 P. M. wind W. Oct. 6th, at 4 A. M. set whole topsails and top gt. sails; at 6 A. M. saw the Grand Cayman bearing E. N. E. about 8 miles. [Drift and run since noon of 5th, 44 miles, courses S. by E., S. by W. and S. W.] At noon, light winds, in lat. 19° 15′, lon. D. R. 81° 42′.

The ship's barometer, when the gale hauled to S. W., was observed at 28·40. [Add 0·10 for its error of adjustment, as since compared with mine in New York, gives 28·50 inches. It is not certain that this was its lowest point. The nearest approximation of the ship's track to the axis *line* I estimate at 85 miles R.; which was *after* the axis of the gale had passed the ship. It will be perceived that the ship was constantly running or drifting towards the axis line, till after the axis and the heart of the gale had passed.]

20. Brig *Rebecca*, at St. Cruz, south side of Cuba, lat. 20° 44′, lon. 78°, [225 miles R.] Oct. 1st, had a heavy gale from S. W. with a heavy sea; in which a barque named the *Barker* was driven on shore. [First gale.]—Oct. 4th, it blew a hurricane from the southward, and the *Barker*, which had been got off, again went on shore. The sea now made a fair breach through the houses in the town, which is built on a single street, parallel to the shore. The heaviest part of the hurricane varied 3 or 4 points in direction, blowing in tremendous squalls, from S. S. E. to S. S. W.; and was attended with lightning and rain for 12 hours without intermission.—(*Mate of Rebecca and logbook.*)

21. Schr. *Arab*, was lost on Point San Juan, between Trinidad and Cienfuegos, on the morning of October 4th, and all but the mate perished. [Lat. 21° 44′, lon. 80° 32′, 65 miles R.] The schooner was prevented from getting into St. Jago by the violence of the [first] gale, and was carried to leeward and lost as above stated. [It appears from this case that the wind at Point Juan blew *on* shore, showing the right side of the gale.]

22. Brig *Levant*, from Kingston, Ja., for Campeche, was reported as having encountered the hurricane on the 2d of October, from E. and S. E., and at 5 P. M. was thrown on her beam ends, lost mainmast, and other damage. Next day spoke brig *Homer*, totally

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* Nautical Magazine, February, 1845.

dismasted. [As it is known from several sources that the Homer was dismasted on the 4th of October, there must be an error of two days in the date above reported. This account may serve, however, to show the direction of the wind in the first part of the gale and the probable position of the Homer, as being near the path pursued by the axis of the storm.]

23. At Trinidad, south side of Cuba, [lat. 21° 42′, lon. 80° 11′, 83 miles R.,] the hurricane was peculiarly severe, as also in its vicinity, blowing down houses in the town and destroying the plantations.

24. At Cienfuegos, [Xagua, lat. 22° 6′, lon. 80° 42′, 45 miles R.] the gale, though very severe, did less damage than at Trinidad. [Owing, probably, to the deeply sheltered position of the place.]

25. On the right border of the storm we find that the master of the Schr. *Ermina*, (at Nassau, N. P.) reports the loss of three vessels on the west coast of St. Domingo [Hayti] near Gonaives, in this gale. [Say in lat. 19° 38′, lon. 73°, 550 miles R. Vessels in this great bight or bay, were peculiarly exposed to being driven on shore by the S. W. winds under this border of the storm.]

26. At Turks Island, as reported by Capt. VARNEY, the gale blew hard from the southward; but not a hurricane. [Lat. 21° 22′, lon. 71° 8′, 565 miles R.]

We take now the accounts from Cuba and other reports, from the left side of the gale, as far onward as will include the peninsula of Florida and the Bahama Bank.

27. At Santiago de la Vegas, 50 miles westward of Havana, [lat. 22° 57′, lon. 83° 5′, 112 miles L. (?)] the hurricane began at 9 A. M. of Oct. 4th, and continued 14 hours.*

28. At San Christobal, on the southern slope of Cuba, about 60 miles S. W. by W. from Havana, [say 105 miles L.] Oct. 2d, it began to blow from the N. and every body supposed that the rains were going to cease. The wind continued to increase, and on the afternoon and night of the 3d it began to cause damage to the cornfields.

But it was reserved for the night of the 4th to consummate the destruction, and in every hour the wind seemed to increase. The gale continued till about 10 o'clock in the morning of the 5th, though the wind had begun slowly to subside.

29. At San Antonio de los Baños, [about 30 miles S. W. from Havana and 92 miles L.] Oct. 1st, a light dry wind from N. E., which by the morning of the 2d was quite strong; at noon it was more violent, changing during the evening and night to the East, and by the morning of the 3d had finished at South.

At midnight of the 3d there was rain, which increased and continued all the day and night of the 4th. About 5 P. M. of the 4th, the wind had begun to blow from the S. E. and it gradually increased till 10 P. M., when it had passed to the East. At 4 A. M. of the 5th, the wind was at E. N. E. and blew with inconceivable fury, and the rain fell in torrents. At 5 A. M. it blew from due North, and from that time till 10 A. M. or more properly 12, no human pen can paint its effects.

30. At Batabano, [south shore of Cuba, 32 miles S. by W. from Havana and 76 miles left of the axis line,] at 5 A. M. Oct. 1st, it began to blow from the N., and on the 2d at the same hour, hauling towards the N. W., it increased to a hurricane until the 3d, when it had subsided at the same time that some rain began to fall.

The 4th of October was rainy, and the wind blew from N. E. until 8 P. M., when the hurricane began; at 3 P. M. [?] of the 5th it became calm, the wind changing to N. W., whence it again blew strongly for two hours and then ceased.

31. At Guatao, five leagues from Havana, Oct. 2d, at 4 A. M., wind E. N. E., strong, in successive gusts and rain in transient squalls. At 7 A. M. wind stronger at E. N. E.; at noon, feeble from E. N. E.; at 6 P. M. wind hardly sensible, direction the same. Oct. 3d, all day a slight drizzling of rain with a light breeze.

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* The accounts from the island of Cuba are chiefly taken from the Diario de la Habana, as translated by Mr. John H. Redfield. The distances are estimated in a direct line.

Oct. 4th, wind N. E., hardly sensible; cloudy; noon, wind E. N. E., fresh, drizzling rain with intermissions; 8 P. M. wind N. E., strong and constant; continued rain; at 10 P. M. less rain and more wind. Oct. 5th, 1 A. M., no longer wind—it is a destructive hurricane; 4 A. M., some rain, wind N. N. E., frightful; 6 A. M., houses falling, roofs blowing off, &c. &c.; some rain; 9 A. M., wind N., more furious; noon, rain ceased; wind N. N. E., relaxing; at 6 P. M. the sun shone a quarter of an hour; wind N. W., light.

32. At Havana, [lat. 23° 9′, lon. 82° 19′, about 85 miles L.] as per Capt. FOSTER, ship *St. Mary*, Oct. 2d, it blew a gale from E. N. E., sufficiently strong to require the aid of the best bower anchor; atmosphere continued dry, but enveloped by a fine haze. Toward sunset the wind moderated, and during the night veered to E. S. E., with an overcast sky. This state of weather continued during the 3d, and in the evening there was much lightning in the S. E. quarter.

Early on the 4th, the wind was moderate from S. E., and cloudy, weather apparently unsettled. About 9 A. M. the wind veered gradually to E. S. E., E. N. E., and finally settled at N. E. by E., with squalls of wind and rain, and dense masses of clouds came swiftly from that quarter, but no lightning was seen. The squalls increased in violence with torrents of rain, continuing so through the night till early on the morning of the 5th, when it blew a terrific hurricane. As day dawned on the 5th, vessels in all directions were drifting their anchors, coming in collision, dismasting and sinking each other. The St. Mary [which we have seen was roughly handled in the two former hurricanes] was the only American vessel that rode out the gale without damage. At 10 A. M. the wind veered to North, and thence gradually to N. W. Even then the gusts were not exceeded in violence. By 5 P. M. the wind subsided to a moderate gale, with streaks of clear sky in the West. By 9 P. M. the wind became nearly calm, with a brilliant starry sky.

Sunday, Oct. 6th, ushered in most delightful weather. The extent of damage to the shipping was very great. Many were dismasted, numbers were sunk, and several had overset, remaining bottom up. The southwestern shores of the harbor were strewed with wrecks, and this in a port unrivalled for its secure anchorage.*

33. A barque and a brig arrived at Havana on the 6th, which had encountered the gale of the previous day *to the N. W. of the Tortugas*, where they experienced only an ordinary gale of wind, reducing them to reefed topsails. [(?) 260 miles L.]

34. At Matanzas, [lat. 23° 3′, lon. 81° 41′, about 50 miles L.] during September, the barometer exhibited few remarkable variations; but on the 1st of October it was 29·60 inches. In a few hours appeared a strong N. E. wind, which continued without change till the 4th, when the wind ceased and it began to rain abundantly.

But the barometer, *which generally stood at 30 inches*, notwithstanding the calm remained at 29 inches on the 4th, which gave reason to suspect that we should have heavy N. E. winds. In fact on the morning of October 5th it fell to 28 inches, thus indicating the terrible hurricane which almost immediately made its appearance. The wind, which at 10 P. M. of the 4th had begun to increase by degrees, at 2 A. M. on the 5th blew with such violence that no doubt could remain of the immense destruction which it threatened. When the day dawned it continued to blow from the N. E. with unheard of fury, and it was not till 10 or half past 10 A. M. that it began at all to abate. Shortly afterwards it veered continually and finally settled at West, whence it again began to blow with the same violence as in the morning. But at 2 P. M. the barometer began to rise, promising the cessation of the gale, which soon after took place. In fact, at three o'clock the storm

* Capt. BOXER, of R. M. steamer *Trent*, says in his journal:—On arriving at Havana [Oct. 7th] we found the shores of the port strewed with wrecks—some bottom up, others with their masts out of water, and others washed partly on the wharves. From the consul's statement it appeared they had a heavy gale on the 2d of October, which lasted 24 hours. The weather then became hazy, (unusually so,) with light rain, rapidly driven. On the 4th, the sympiesometer and barometer gave indication of some awful change, particularly the former: and shortly after this warning, a furious hurricane set in from N. E., such as the oldest inhabitants have never before witnessed. Seventy two ships were either upset or driven on shore, and others dismasted. Houses were unroofed, windows blown in, and the crops seriously injured; damage computed at a million sterling. I tried to obtain the particulars of the fall of the barometer, but singular to say, no one could give me an exact account. All they stated was, they had never seen it lower.

had entirely yielded; and on the 6th at 9 A. M., the barometer stood at 29·80, and the weather was tranquil.

35. At Cardenas, 26 miles eastward of Matanzas, [lat. 23° 2′, lon. 81° 15′, about 27 miles L.] at half past 11 of the 4th, after a heavy shower it began to blow a violent hurricane. The wind first prevailed at East, and went about to S. W. and N. with continual rain. The wind [hurricane] lasted for 24 hours.*

[I have no accounts from Port Cabayrien, Neuvitas, and other ports on the north coast of Cuba, in the right side of the gale, where the wind would be found blowing off the shore and therefore less violent in its effects. For the character of the precursory storm off the N. side of Cuba, near lon. 77°, see 45*b*.]

36. Schr. *Tasso*, off Havana, bound northward through the gulf of Florida. Capt. Howe says: The gale commenced with me Oct. 1st, in lat. 23° 30′, lon. 82° 40′, the Mariel Tables bearing nearly S., wind E. S. E. On the 5th at 2 A. M., it increased to a perfect hurricane; at 4 A. M. lost boat and sixty bales of cotton by the boarding of a sea, wind at this time E. N. E.; at 6 A. M. wind N. E.; at 8 A. M., N. N. E.; at 10 A. M., North, and the heaviest of the hurricane; at 2 P. M. of Saturday the 5th it had abated considerably, then blowing N. N. W. to N. W. and so continued till 4 P. M. when it changed to N. W., and at midnight I once more made the land, bore up for Havana, and arrived at 10 A. M. Sunday the 6th.

37. Ship *Columbo*, for New Orleans, took the gale at 11 P. M. of Oct. 4, near Cat Keys, (west edge of Bahama Bank,) which increased to a severe hurricane on the 5th from S. E., [shipping report of the time says E. S. E.] which suddenly abated at about 5 P. M. when off the Double Shots, between Salt Key Bank and Florida Reef, [? lat. 24° 15′, lon. 80° 30′, about 30 m. L. ?] and in twenty minutes came out from N. N. W. and N. W., and finally abated at 2 A. M. of Sunday, Oct. 6th. Lost sails, bulwarks, &c. [These winds, with the lull and shift to the opposite quarter, prove the ship to have been in the axis path and not far from its center.]

38. From the military post at Key West [lat. 24° 27′, lon. 81° 50′, about 118 miles L.] we have the following observations.

Date.	Barometer, (average.)	Wind.	Rain.	Thermometer at 3 P. M.	Wet bulb thermometer.
Oct. 1st.	30·10	E. N. E. to N. N. E.; a gale.		83°	80°
2d.	30·01	southeasterly; strong.	0·17 in.	78	76
3d.	29·94	N. E.; light.	1·96	78	76
4th	29·84	E. to N. E. increasing; strong.	1·75	75	75
5th	29·42	E. N. E. to W.; severe gale.	9·62	72	72
6th	30·00	N. W. strong; moderate.		79	73
7th	30·17	E. to N.; light.		84	77
8th	at 9 A. M. 30·26	N.; moderate.		84	79

The following hourly observations made during the hurricane are added by the medical officer, commencing at 1 A. M. Oct. 5th. These are highly valuable.†

Hours.	Barometer.	Winds and strength	Hours.	Barometer.	Winds and strength.
1 A. M.	29·768	E. N. E. 7	12, noon.	29·217	N. E. by N. 9
2	·729	E. N. E. 7	1 P. M.	·166	N. E. by N. 9
3	·516	E. by N. 8	2	·134	N. by E. 9
4	·457	E. N. E. 8	3	·185	N. 9
5	·433	E. N. E. 8	4	·264	N. by W. 9
6	·402	E. N. E. 8	5	·410	N. N. W. 8
7	·335	N. E. by E. 7	6	·455	N. W. 8
8	·418	N. E. 7	7	·520	N. W. by W. 6
9	·536	N. E. 8	8	·551	W. N. W. 8
10	·331	N. E. by N. 9	9	·587	W. 7
11	·272	N. E. by N. 9	10	·642	W. 6

The gale was blowing in strength, from E. N. E., at 9 P. M. of the 4th. Sky wholly obscured from 1 A. M. to 5 P. M. of 5th. Rain from 1 A. M. 7·97 in. [Crisis of the gale about 2 P. M of the 5th, according to the barometer.]

* The order of changes, here appears like a typographical error. Possibly it may have been written S. W. by the N.; or, S. W. and W.

† The scale of the wind's force adopted for the meteorological returns from the military posts, is from 0 to 10. No. 4 denotes a brisk wind and 9 a hurricane.

In an account printed at Key West, it is stated that the unequalled fury of the gale when at its height can scarce be conceived. It swept every thing before it—houses, fences, trees, vessels—and almost every thing in its course was levelled with the earth or borne off with frightful velocity.

39. At Indian Key, off the S. point of Florida, [lat. 24° 47′, lon. 80° 48′, about 75 miles L.,] most of the houses remaining there were blown down and all the wharves destroyed.

40. Brig *Ventrosa*, was lost on the Bimini Islands in the hurricane. [W. edge of the Bahama Bank, lat. 25° 40′, lon. 79° 12′, about 35 miles L.]

41. At Jupiter Inlet, St. Louis Sound and Indian river, on the E. shore of Florida, between lat. 26° 30′, and 28°, the gale was severe on the 5th, causing a great influx of the sea. [This part of the coast is 112 to 150 miles L. of the axis line.]

42. At Fort Brooke, head of Tampa Bay, Florida, [lat. 27° 57′, lon. 82° 35′, about 300 miles L.,] there was no rain, except light showers on the afternoon of Oct. 2d. The lowest observations of the barometer were made on the evening of the 5th and morning of the 6th, 29·79 in. It may have been lower in the night. The daily *averages* of the barometer and state of the winds, were as follows, viz.—Oct. 1st, bar. 30·50, wind, E., 3; Oct. 2d, bar. 30·16, winds N. E. and E., 1 and 4; 3d, bar. 30·06, wind E., 1; 4th, bar. 29·94, wind N. E., 1; on the 5th, bar. 29·84, wind E., 2, 4, 6, 4;* 6th, bar. 29·88, winds N. E., 3, 2, 1; 7th, bar. 30·07, calm. [Fort Brooke is not more advanced in the track of the storm than the island of New Providence, Bahamas; and its deeply embayed position, on the west side of the Florida peninsula, doubtless contributed to its shelter from the force of the gale.]

43.† At Charlotte Harbor, [west coast of Florida, lat. 26° 48′, lon. 82° 5′, 228 miles L., and less advanced in the track than Fort Brooke,] the gale blew from N. E. and was much stronger than at Tampa Bay. Its violence greatly increased, on that coast, as we go S. toward Key West, as I am informed by Capt. PARKER; this being in fact a nearer approximation to the center path of the gale.

44.† At Apalachicola, [lat. 29° 43′, lon 85° 05′, near 475 miles L. of axis line,] there was no gale; the winds were moderate from the N. E., with clouds flying somewhat briskly from that quarter.

45*a*. At St. Augustine, [Fort Marion, E. coast of Florida, lat. 29° 40′, lon. 81° 35′, 305 miles L.,] Oct. 1, bar. (average) 30·18, winds N., 4 to 8; 2d, bar. 30·18, wind E., 6; 3d, bar. 30·07, wind E., 3, 2; 4th, bar. 29·90, wind N. E., 1. On the 5th, bar. 29·99, 29·82, winds N. E., 3, N., 4, 7, N. E., 8, drizzling rain at 2 P. M.; violent wind at 10 P. M. equal to 9. [Heaviest of gale in the night.] 6th, bar. 29·75, 30·01, winds N. W. 5, 6, N. E. 3, 0; 7th, bar 30·13, wind W. 1, 0. The gale set in brisk A. M. on the 5th. [Distance from the axis line greater than at Tampa Bay, but the position of St. Augustine, on the E. coast, was far more exposed to the gale. The state of the barometer and winds show that both these places were toward the left border of the gale, which in passing onward did not fully extend its force to Savannah and Charleston.]

45*b*.‡ Brig *Demarara*, at and from Neuvitas, N. side of Cuba, Sept. 28th, fair, light breeze from N. N. E.; 29th, fair, strong breeze from N. N. E.; 30th, begins calm, cloudy and hazy, 8 A. M. light breeze from N. N. W. Put to sea. Noon lat. 21° 46′, lon. 77° 08′; [Bahama Old Channel;] 1 P. M. wind S. W., thick and hazy, looking squally in the S. E.; 5 P. M. wind N. N. W., took in sail; 10 P. M. wind S., furled the courses, close-reefed foretopsail, and double-reefed main-topsail. [Reefs on edge of Great Bahama Bank bearing northerly.] Oct. 1st, at 2 A. M. wore ship to westward and close-reefed the main-topsail; 4 A. M. wore ship; 8 A. M. kept off, and ran on to the edge of the Bank and then hove to, head to westward—continues blowing with a dangerous sea; noon, lat. 22° 22′, lon. 77°, wind S., a perfect gale, wore ship to the eastward; lying to under close-reefed topsails; 6 P. M. wore ship to westward; 8 P. M. wind S. E. by E. Oct. 2d, at 2 A. M. wore ship, head

* Where successive entries for the same date are given for the military posts, they refer to the successive daily periods of observation, which are respectively, sunrise, 9 A. M., 3 P. M. and 9 P. M.

† 43 and 44 are given on the authority of Capt. PARKER, who was then at Apalachicola, and afterwards acted as a commissioner at Key West, on vessels damaged in this gale.

‡ This case with some others was not received in time for insertion on the map.

to E. N. E., a little more moderate; 3·30 A. M. wore ship to westward and then kept off and made sail; 7 A. M. wind E. S. E., shook out all reefs and set top gt. sails; [end of first gale;] 9·30 A. M. run off the Bank and then followed the edge down; 11 A. M. wind E. by S.; 11·30 A. M. made Ginger Key; noon, lat. 22° 43′, lon. 78° 11′; P. M. overcast, and fresh breeze from E. to E. N. E. Oct. 3d, 2 A. M. set stud. sails; 8 A. M. took in lower stud. sails; fresh breezes and flying clouds; noon, lat. 25° 05′, lon. 79° 32′; light breeze E. by N., weather thick and overcast; 4 P. M. wind E. N. E.; 8 P. M. E. by N.; ends light breezes and flying clouds.

Oct. 4th, 4 A. M. wind E. S. E., rainy and squally; 7 A. M. wind S. E.; 10 A. M. wind light from S. S. E. and rainy; noon, lat. 27° 09′, lon. 79° 32′, thick rainy weather, wind E. N. E.; 3 P M. took in stud. sails, looking very squally; 6 P. M. heavy rain, ends thick and hazy. Oct. 5th, 1. A. M. wind E. N. E., strong; 6 A. M. in top gt. sails; 8 A. M. wind N. E. by E., single-reefed the topsails; rainy and squally; noon, lat. D. R. 28° 56′, lon. 79° 43′, squally, rainy and winds baffling: 2 P. M. wind N. E.; 5 P. M. a heavy squall from N. E.; at 6 P. M. hove to, under close-reefed topsails, head to eastward; blowing a heavy gale and a bad sea; 9 P. M. up E., off E. S. E. Oct. 6th, first part more clear, but a constant gale and very dangerous sea; 9 A. M. gale had veered to N. N. W.; noon, lat. obs. 29° 59′, lon. 79° 20′, clear weather and strong gale from N. N. W.; 1 P. M. set single-reefed topsail and fore-topmast staysail; 6 P. M. shook out all reefs and set jib; midnight calm and cloudy. [Distance from axis line at the height of the gale, 187 miles L.]

We will now look toward the axis of the storm near the Bahamas, and then follow the accounts which relate to the right side of its axis, as far onward as Bermuda on that side.

46. Brig *Rebecca*, [second of this name,] from Cienfuegos, on the 5th of Oct. encountered a tremendous gale from S. E., which shifted part of the cargo, but did no other damage. [This route and date, with the direction of the wind given, place this brig in the gulf of Florida, probably near the Salt Key Bank.]

47.* Brig *Saratoga* was crossing the Bahama Bank, Oct. 5th, when it began to blow, at 10 or 11 A M., from E. S. E. or S. E. by E. At noon saw Orange Key ahead; split close reefed fore-topsail and set reefed foresail, in attempting to weather it. Kept away and run to the N. of the Key; struck in passing off the Bank, about 2 P. M. and sprung a leak; gale increasing from S. E.; wore ship and stood back for the Bank, intending to run under Orange Key. The gale now hauled southward, and the brig having no after sails, fell off and drifted on the Riding Rocks, under fore-topmast staysail and reefed foresail, which were blown away when she struck, about 3 P. M., [lat. 25° 15′, lon. 79° 4′.] Thumped on the rocks till about half past 4 P. M., when she had worked over into deeper water. Both anchors were then dropped, which failed to hold her, when the stays were cut and the masts blew over; the wind now southerly; the sea was breaking over the vessel and sweeping off every thing movable. Kept the pumps going till about 7 P. M., when the brig sunk in about 4½ fathoms. At this time the narrator was entangled with the poop deck, which had separated from the vessel. He held on for a short time, was washed off, and floated on different articles, he thinks, for an hour; was then thrown again in contact with the poop deck, on which was a passenger, and to which, by a small rope providentially attached, he kept fast during the night.

Towards morning of the 6th, the gale began to abate, and about 4 A. M. the wind-spray had so far ceased that the stars were visible. At sunrise the wind was strong from the southwestern quarter and the two survivors were drifting eastward over the Bank. By 9 A. M. the gale so abated as to allow them to stand up. At noon it was nearly calm, and till about 10 P. M., when the wind came out from the eastward. This wind, during the night of the 6th, drove them off the Bank into the Gulf Stream, where they floated at the mercy of the waves, without food or drink, till Oct. 11th, when they were taken off, in a perishing state, by the barque *Zida*, in lat. 25° 40′, [(?) 28° 40′,] lon. 79° 45′. [Mr. S. was

* From Mr. SIMONSON, 2d mate and survivor.

below at the commencement of the gale, and was called to reef the foresail at half past 11 A. M. I deem it proper to present the above details, but in estimating them, allowance may be made for the position and condition of this suffering observer. Orange Key and Riding Rocks are near the line given for the route of the storm's axis, but its actual course may have been a little devious from a direct line, and here more westward.]

48. Ship *Chester*, passed Stirrup Key, [Berry Islands,] Oct. 11th, was boarded by the keeper of the light on Abaco, [Hole in the Wall, lat. 25° 51′, lon. 77° 09′, about 70 miles R.,] who reported that the hurricane had blown down all the houses. The wind was heaviest from S. E., on the morning of the 6th.

49. Schr. *Magnet*, Oct. 5th, 6th, near E. side of Abaco, [lat. 26°, lon. 77°, about 70 miles R.,] had a heavy gale of wind from E. S. E. to S. S. E., during which lost sails and spars, was thrown on beam ends, &c. [Latter part of gale not mentioned.] Saw Schr. *Chase* about one mile from Abaco, wind blowing on shore. Brig *Partridge* was also dismasted near Abaco.

50. Barque *Reform*, for Mobile, at noon Oct. 5th, fresh breezes from S. E. and cloudy; double reefed the topsails; at 2 P. M. made sail, and stood in W. S. W. for Abaco. At 5 P. M. made the land ahead and hauled the ship to the wind; at 6 P. M. tacked ship to the eastward, the wind increasing, with a heavy sea from S. E.; close reefed fore and main-topsails, furled courses, jib, and spanker; at 9 P. M. wind still increasing from S. E.; at 11 P. M. fore-topmast staysail blew out; took in fore-topsail and hove to under close reefed main-topsail, blowing heavy. Oct. 6th, at 1 A. M. the gale increased to a hurricane and blew away the furled sails from the gaskets. At 2 A. M. the gale suddenly subsided and the wind changed to S. W. [N. of Abaco, a few miles R.] In 30 minutes it was again blowing a hurricane from S. W., as hard or harder than before. About daylight it began to moderate, and at 11 A. M. the wind had veered to W. Lat. at noon 27° 31′.

51. Ship *Star Republic*, took the gale Oct. 5th, lat. 26° 46′, lon. 76° 58′, in company with *Reform*. Increased to a hurricane from E. S. E. till about 2h. 30m. A. M. of the 6th, when it died away, and in about 30 minutes shifted from E. S. E. to W. and came out from that quarter with great fury. At the time of the lull the barometer stood at 28·10, [or as corrected 0·14 for its adjustment, 28·24,] when it rose rapidly 3-10ths in 30 minutes, *and then remained stationary for two hours;* rising again as the gale abated. Lat. at noon of 6th, 27° 25′, lon. 77° 15′ by computation. [A few miles R. of our axis line.]

52. Brig *Josephine*, encountered the hurricane on the evening of Oct. 5th, 21 miles N. E. of the Hole in the Wall, [or S. E. point of Abaco,] blowing from S. E.; cleared the E. point of Abaco, and scudded before the gale till 3 A. M. of the 6th, when it lulled, and then came out from N. W., blowing a hurricane for four hours, which dismasted the brig. Lat. at noon 27° 30′, lon. 76° 30′. (?) [The brig's position at the time of the lull is supposed to be at the axis of the gale, which may have been to the right of our axis line.]

53. Nassau, N. P. [lat. 25° 04′, lon. 77° 18′, about 90 miles R.] We experienced a severe hurricane on the Banks on the night of Oct. 5th, and the loss of lives and property has been greater than that of any previous gale for some years. In this harbor, from the quarter we had the wind, S. E., all was protected, and no damage of consequence.—(*Bermuda Gazette.*)

A letter from an officer at Nassau, states that the gale commenced with the wind from S. E., and gradually drew round to S., ending about S. W.—(*Nautical Magazine.*)

54. Letters from Long Island, Bahamas, [lat. 23° 20′, lon. 75° 15′, about 275 miles R.,] state that the gale was by no means severe there, blowing only in squalls attended with torrents of rain. Rum Key has also suffered little from its fury.—*Ber. Gaz.* [Lat. 23° 41′, lon. 74° 43′, about 280 miles R.] These two islands are on the S. E. border of the Bahama group, and opposite the eastern part of Cuba, the highlands of which would afford some degree of protection, under the R. side of the storm.]

55. Ship *Berlin*, Oct. 5th-6th, lat. 26°, lon. 75°, [175 miles R.,] experienced a hurricane from S. E., veering S. W., with a heavy sea.

56. Barque *Lagrange*, Oct. 5th-6th, lat. 26° 30′, lon. 75° 30′, [127 miles R.,] experienced a very severe gale from S. S. E. to S.; which increased to a hurricane at 3 A. M. Lost bulwarks, deck load, &c.

57. Brig *Herald*, Oct. 6th, lat. 30°, lon. 73° 30′, [75 miles R.,] had a heavy gale from S. E.; hove to; cut away fore-topmast; gale still increased and hove the brig on her beam ends, and did not right again till the mainmast was cut away.

58. Ship *Sea Lion*, Oct. 6th, lat. 28°, lon. 70°, [330 miles R.,] experienced a heavy gale from S. E., which veered round to W. Lost foresail and fore and main-topsails.

59. Ship *Charlotte*, experienced the hurricane Oct. 6th, from S. E. to N. W., lat. 32°, lon. 73°, [about 15 miles R.] Lost every thing above the tops, with lower sails, yards, &c.

60. Ship *Russell Glover*, had the hurricane Oct. 6th, lat. 31° 32′, lon. 71° 45′, [95 miles R.] Lost spars, &c. &c.

61. Schr. *Victoria*, left New York Oct. 1st, with fine westerly winds, bound for Cuba. Oct. 5th, winds became eastward with thick weather and moderate, till 9 A. M. of 6th, when it commenced blowing in strong puffs from S. E., with thick mists or sprays, clouds flying very swiftly. The gale increased in violence and fury, and the vessel was reduced to balance-reefed mainsail and kept to the wind. At 11 A. M. it became so violent that the vessel was blown completely over upon her beam ends, her decks swept of every thing, and lay with no prospect of righting till the masts were cut away, when she came up, a helpless wreck. It was afterwards found that the wind was gradually shifting round to the southward, and from that to the westward. At 6 P. M. the gale had much abated, and at 10 P. M. had fine clear weather. Position at noon reckoned to be in lat. 32°, lon. 72° 30′, [38 miles R.] Had during the next day the heaviest cross sea Capt. BUNCE had ever witnessed.

62. U. S. brig *Pioneer*, Lieut. SHAW. Oct. 1st, 4 P. M. winds moderate from eastward, air 83°, water 84°, barometer 29·91. Midnight, wind S. E., air 80°, water 84°, barometer 29·83. Oct. 2d, A. M. moderate southeasterly breezes, rainy and cloudy; at noon air 68°, water 85°, barometer, 29·87; lat. obs. 25° 51′ 30″, lon. chr. 64° 38′ 30″; current S. half E. 29 miles. P. M. light southeasterly and variable winds; midnight air 80°, water 83°, barometer 29·78; ends squally with thunder, lightning, and rain,

Oct. 3d, A. M. winds moderate and variable, from N. E. to S. S. E., with frequent and heavy rains; ends pleasant; passed large quantities of sea-weed; noon, air 84°, water 82°, barometer 29·75; lat 26° 48′, lon. 65° 44′ 30″; current S. E. by S., 18 miles. P. M. moderate and variable breezes, between S. E. and S. W. and squally; ends cloudy with occasional heavy showers; air 79°, water 80°, barometer 29·70. Oct. 4th, A. M. moderate to fresh breeze from S. W.; 8–12, cloudy with passing squalls; air 82°, water 82°, barometer 29·70; lat. D. R. 28° 31′, lon. 67° 39′. P. M. moderate and variable southwesterly breezes, with squalls and showers, barometer at 4 P. M. 29·67. Midnight, air 79°, water 82°, barometer 29·75.

Oct. 5th, light breeze S. W. to N. W. and southwesterly, squally at 4 A. M., pleasant. Noon, air 83°, water 83°, barometer 29·80; lat. obs. 29°, lon. chr. 67° 58′. P. M. light and moderate breezes from S. W. to S. E. and S. S. E.; at 8 P. M. barometer 29·80; from 8 to midnight wind settling at S. S. E., with occasional squalls of wind and rain; barometer falling; air 81°, water 82°, barometer 29·78.

Oct. 6th, A. M. begins moderate, with passing squalls of rain, wind S.; 4 A. M. barometer 29·70, wind S. hazy; 8 A. M. barometer 29·65, fresh gales and hazy weather, with heavy squalls; at 10h. 30m. passed a schr. hove to; at 11h. 40m. gale still increasing. Noon, air 82°, water 78°, barometer 29·49; lat. obs. 30° 30′, lon. chr. 69° 52′. P. M. commences with fresh gales from S. and heavy squalls with thunder and rain; at 1h. 30m. was struck by a violent hurricane from S. S. W. while under close reefed foresail, single reefed fore-spencer, and fore-topmast staysail. The hurricane continued with nearly unabated violence during the watch, and barometer fell to 29·45, but rose again to 29·49 at 4 P. M. From 4 to 5 P. M. gale from S. W. and S. S. W. with a very heavy sea; from 5 to 6, wind moderated, but the sea the same; at 5h. 30m. hove to; from 6 to 8 P. M. moderate gale and very heavy sea; weather clear; lying to; 8 P. M. wind W. S. W. and from 8 to midnight high winds and passing clouds; sharp lightning all round the horizon; air 80°, water 82°, barometer 29·74. Oct. 7th, from midnight to 4 A. M. moderate breezes, varying between W. S. W. and W. by N, with a heavy swell and passing clouds. At 4 A. M. barometer 29·77; at 8 A. M. 29·82; noon, 29·87; winds W. by S. with a heavy swell. Noon, lat. obs.

31° 24′, lon. chr. 70° 06′. [Had run 40 miles to the northward since 3 P. M. of 6th, besides drift in lying to. Probable position at minimum of barometer, 213 miles R.]

63. Ship *Potomac*, Oct. 6th, at 4 A. M., reefed down the sails with the wind blowing at E.; at 6 A. M. took in foretopsail, gale S. S. E.; at 10 A. M. took in maintopsail, gale S. S. E.; 11 A. M. hurricane from S. S. E., lying under bare poles; at 11h. 30m. was hove on beam ends; cut away the mizenmast, then the mainmast, when she paid off and righted: Wind veering to all points of the compass. Lat. 32° 30′, lon. 71° 30′. [60 miles R.—I infer that the gale blew from the western quarter after these shiftings near the center, but the close of the gale is not mentioned.]

64. Ship *St. Cloud*, Oct. 4th, lat. 33° 01′, lon. 70° 40′, cloudy and light breeze from S. S. E.; night dark and squally, barometer low, and appearance of an approaching storm. Oct. 5th, A. M., wind S. S. E. to E. and calm; lat. 32° 13′, lon. 70° 55′; P. M., light breeze from W. and W. S. W., gradually veering to N. E.; barometer falling till midnight, when it blew a reefed topsail gale. Oct. 6th, gale still increasing, from E. N. E. to S. E.; barometer 28·70, and falling. At 6 A. M. the hurricane had commenced; furled all sail, ship's head to the southward; wind, apparently, nearly steady. At 9 A. M. barometer 28·40, and at a stand; at 11h. 30m. wind had veered to S. E.; noon, no abatement; lat. D. R. 32° 20′, lon. 70° 25′, (?) P. M. commences wind hauling more S., barometer steady at 28·35 to 28·40; 1 P. M. wind S. by E.; 2 P. M. S. S. W. and still blowing as hard as ever, and veering westward; about 3 P. M. the clouds began to break in the S. W., and the gale to abate; 4 P. M. wind S. W. by W., got ship's head to S. S. E. and set a little sail, wind moderating, and veered N. W. and N. N. W. in 12 hours; then in lat. 31° 53′, lon. 71° 40′. [The dead reckoning position on the 6th, seems not to accord with the observed positions on the 5th and 7th. Probable position at noon of 6th about 105 miles R.]

65. Brig *Brothers*, Oct. 6th, lat. 32°, lon. 70°, [150 miles R.,] was thrown on her beam ends and totally dismasted.

66. Barque *H. W. Tyler*, Oct. 6th, lat. 31° 30′, lon. 68°, [265 miles R.,] experienced a severe gale from the S. which blew away the reefed topsails and foresail, and did other damage.

67. The *Clara and Emma* was dismasted in this gale in lat. 32° 23′, lon. 68° 49′, [195 miles R.] and was abandoned in lat. 32°, lon. 76°.

68. Brig *Falcon*, encountered the gale Oct. 6th, in lat. 32° 50′, lon. 65° 40′, [315 miles R.] commencing from S. S. E. Was hove to from 4 P. M. till midnight. Two hours after its commencement, the gale began to veer gradually round to S. and S. W., and abated at W. It commenced blowing with a clear sky, but the clouds thickened up in the evening. A very heavy and irregular sea was running on the 7th.

69. At Bermuda, lat. 32° 15′, lon. 64° 40′, [380 miles R.] the following observations were made by JAMES IRWIN, signal director at Mt. Langton.

Date.	Hour.	Winds.	Force.	Weather.	Ther.	Barom.
Oct. 1,	9 A. M.	S. W.	4	c.	77	30·12
" 2,	9 A. M.	S. S. W.	5	c. m.	75·5	30·11
" 3,	9 A. M.	S.	3	c. m. p.	77	30·19
" 4,	6 A. M.	S. by W.	5	c. m. d.	70	30.07
" 4,	9 A. M.	S. W.	4	c.	76·5	30·04
" 6,	9 P. M.	S.	8	c. m.	76·5	29·85
" 7,	9 A. M.	S. W.	2	b.	76	29·94
" 7,	2 P. M.	N. W.	3	c.	78	30·02

An interruption occurs in these observations, Oct. 5th and 6th, but a daily series by an officer at the naval station, sent me by Col. REID, shows that the barometer at 10 A. M., of both 5th and 6th, was but little below the mean for October, and the wind is given, on the 6th, as S. S. E., 6; rain, 0·27 in. on the 5th, and 0·28 in. on the 7th or the night previous.

The roaring of a heavy sea on the reefs in the morning of the 7th, was generally noticed; and attentive observers at Bermuda promptly announced that a great gale had passed to the westward of the island, in the direction of Newfoundland.

Having followed the gale thus far, on the right side of its path, we may now return and trace its progress and character on

the left side of its axis and along the American coast, from Florida towards the gulf of St. Lawrence.

70. Brig *Leonora*, bound southward, encountered the gale Oct 5th, between 5 and 6 P. M., preceded by a very heavy rain. During the night it blew heavy from E. S. E., with increasing force. At midnight hove to with head to southward, and so continued till the height of the gale, when, although under bare poles and an exceedingly stiff vessel, she was gradually blown over upon her beam ends by the force of the winds upon her spars and rigging, and lay buried in the sea, till, no hope appearing, the rigging was cut, when the masts instantly went over, and she righted with six feet water in the hold. The sails had been previously blown away, after being furled with strong additional lashings. About 9 A. M. of the 6th, the wind hauled suddenly to the northward, without any abatement, and continued blowing a severe hurricane, for about three hours longer, when it abated with the wind at N. W., and we judged ourselves then in lat 30° 40′, lon. 74° 45′. [Being a few miles L., and nearer the axis line than at the shift of the wind at 9 A. M. Capt. COLLINS had no chronometer, and the position may have been more westward than is here given.]

71. Ship *Arkansaw*, from New York for Mobile, had the storm commence gradually on the night of Oct. 5th, and at 3 A. M. on the 6th was blowing a full gale from E. S. E., which at 8 A. M. had increased to a terrific hurricane, from the same quarter. At half past 9 A. M. the wind suddenly abated, hauling at the same time by the N., and in fifteen minutes from the first lull, had set in again in full fury from W. N. W., which soon dismasted the ship. Capt. BUNKER, in 32 years service, had never seen any thing like it in violence and strength. After blowing from this quarter for near two hours, the hurricane began to relax in force till reduced to a common gale of wind. At midnight the gale subsided. Position at the shift of the gale about lat. 31° 30′, lon. 75°. [55 miles L.]

72. Brig *Sterling*, for New York, Oct. 5th, at noon in the Gulf Stream, lat. 32° 31′, lon. 78°, [233 miles L.,] fresh breezes from N. E. and cloudy, heading E. S. E., all sail set; 3 P. M. took in light sails; 5 P. M. single reefed topsails and trysail; 6 P. M. tacked again to E. S. E. and at 8 to N. N. W.; took in mainsail and jib and tacked to E. by S., the gale increasing and hauling northerly; at midnight close reefed topsail and trysail and furled the foresail. Oct. 6th, at 4 A. M., wind N.; at 8 A. M. took in foretopsail. At noon heavy gales from N. N. W. and squally, with a high sea; lat. 33° 04′, near the outer edge of the Gulf Stream, [about 150 miles L.,] at 2 P. M., wind N. W., strong gales and rainy, lying to under close reefed main-topsail. At 5 P. M. began to make sail; at midnight light airs and cloudy.

73. Savannah barracks, Geo., lat. 32° 05′, lon. 81° 07′, [370 miles L. of axis line.] Oct. 5th, winds N. to E., 1; 6th, W. (?), 1 to 3; 7th, W. 1 to 2. No rain nor gale reported.

74. Augusta arsenal, [470 miles L. and 100 miles N. W. of Savannah,] daily average of barometer: Oct. 1st, 29·843; Oct. 2d, 29·823; 3d, 29·736; 4th, 29·564; 5th, 29·546; 6th, 29·488; 7th, 29·592. Winds from 2d to 5th light, chiefly S. W.; 6th A. M. N. E. 3; P. M N. W. 1.

75. Charleston, (Ft. Moultrie,) lat. 32° 46′, lon. 79° 46′, [335 miles L.] Oct. 1st, barometer, (av.) 30·375; 2d, 30·310; 3d, 30·054; 4th, 29·875; 5th, 29·975; 6th, 29·803; 7th, 30·10. Winds, 5th, N. 3, 4, E. 4, N. N. E. 4; 6th, sunrise, N. N. E. 4; during day, N. W. 4; 9 P. M. W. 3; 7th, variable, 2. [The last three places appear to have been little exposed to the gale, as a surface wind, but were all quite within its barometrical influence.]

76. Fort Johnson, near Cape Fear, N. C., lat. 33° 54′, lon. 78° 01′, [300 miles L.] Oct. 6th, A. M., wind E. 6, N. E. 6; P. M., N. E. 5; 9 P. M., W. 2. No rain noticed.

77. Fort Macon, near Beaufort, N. C. lat. 34° 41′, lon. 76° 30′, [270 miles L.] Oct. 6th, A. M., wind N. 3; P. M., N. 6. No rain. [At the last two posts we have the gale blowing in considerable strength, without rain.]

78. Brig *Capt. John*, had the gale in lat. 34° 22′, lon. 76° 20′, [near Cape Lookout, 240 miles L. of axis line.] Shipped a heavy sea, which stove the galley and killed the cook.

79. Barque *Bashaw*, Oct. 6th, lat. 33° 10′, lon. 75° 15′, [140 miles L.] experienced a gale from N. E. which blew away main-topsail yard, top-gallant mast, &c.

80. Brig *Pennsylvania*, Oct. 6th, lat. 32° 40′, lon. 74°, [57 miles L.] was thrown on her beam ends in the hurricane, and totally dismasted.

81. Brig *Emeline*, Oct. 6th, lat. 33° 30′, on the southern edge of the Gulf Stream, [(?) lon. 74° 30′, 117 miles L. (?)] had the gale come on gradually, with a fine small rain, from N. E. to N. N. E., ending N. and N. N. W.; barometer fell to 28 in. [28·15 in. as corrected for index error;] lay at the mercy of the waves with all hands lashed to the weather rail; gale lasted from 4 A. M. to 4 P. M., and continued fresh till 8 or 10 P. M. The gale began to shift northward about noon.

82. Brig *Republic*, Oct 6th, at 6 A. M. was 85 miles east from Cape Hatteras, lon. 74°, [148 miles L.,] where the gale commenced blowing in the morning from E. N. E., gradually increasing and veering to the northward; vessel scudding at the rate of ten knots. At noon the gale was nearly N., blowing exceedingly heavy. Continued to scud through the gale, and the Captain believes the brig could not have stood an hour if brought to the wind. At 3 P. M. run out of the southern edge of the Gulf Stream. The gale ended about 6 P. M. in tremendous squalls from N. W.

83. The Captain and crew of schooner *Evelina* were taken off the wreck, Oct. 7th, in lat. 34° 50′, lon. 74° 30′, having been dismasted the previous day, [about 160 miles L.]

84. Schooner *Rochambeau*, Oct. 6th, lat. 33° 58′, lon. 73° 15′, [72 miles L.] experienced a severe gale, lost head of foremast and received other damage.

85. Brig *Wm. Nelson*, from Hayti, lat. 35°, lon. 74°, encountered a severe gale from N. E. to N. W., which lasted 24 hours, [162 miles L., and subject to the drift of the Gulf Stream.]

86. Schr. *Tioga*, Oct. 6th, A. M. begins with a light breeze from N. E.; at daylight wind increasing, took in topgallant sails and flying jib; 8 A M. double reefed foresail and mainsail, and took bonnet off the jib; thick rainy weather and heavy gale; hove to under two reefed foresail, head to southward, about lat. 35° 10′, lon. 75°, on the inner edge of Gulf Stream, 200 miles L.] P. M. gale increasing from N. E., set storm staysail; from 4 to 5 P. M. gale exceeding heavy and veering northward; 8 P. M. wind N. less severe; midnight, gale had veered to N. W. and continued to moderate; at 7 A. M. of the 7th, made sail on the wind.

87. Ship *Cotton Plant*, was dismasted Oct. 6th, near lat. 35°, lon. 74°, [about 162 miles L.] in a gale from N. E. and N. N. E., which for a time blew a hurricane, and veered to N. N. W. Hurricane abated at 5 P. M., but gale continued violent during the night.

88. Ship *B. F. Lamar*, Oct. 6th, wind N. E., cloudy; 6 A. M. wind increases with rain; noon, lat. 35° 30′, on inner edge of Gulf Stream, [about 200 miles L.,] wind strong from N. E.; P. M. heavy gale from N. E. by N., inclining northerly, with heavy rain; 4 P. M. blew a tremendous hurricane; 6 P. M. the clouds were clearing away; midnight more moderate, set foresail; morning of 7th pleasant.

89. Brig *Clara*, Oct. 6th, experienced a hurricane from N. N. E. to N.; at 5 A. M. broached to, was hove on her beam ends and dismasted; lat. 34° 30′, lon. 73° 30′, [about 120 miles L. Only the *hurricane* part of the gale appears to be reported.]

90. Schr. *Magnet*, [second of this name,] was totally dismasted Oct. 6th, lat. 33° 45′, lon. 72° 30′; Captain and crew taken off the wreck. [About 35 miles L. of axis line.]

91. Ship *Rienzi*, from Rio Janeiro, experienced a tremendous gale, Oct. 6th, from N. E. and E., [(?) E. and N. E. ?] veering by N. to N. W.; lat. 34° 30′, lon. 73° 15′, [100 miles L.]

92. Brig *Growler*, Oct. 6th, lat. 35°, lon. 73° 30′, (?) [138 miles L. ?] encountered a severe gale from E. N. E., and while scudding under-close reefed topsail, the gale abated to a dead calm, and on a sudden shifted to N. W., which hove the brig on her beam ends. [A comparison of this report of the winds with the numerous accounts from this part of the ocean, shows an apparent error in the Growler's position, as above given. Doubtless it must have been much nearer the axis line. Such errors of figures occasionally occur in marine reports; and these should therefore be verified, when practicable.]

93. Barque *Hebe*, Oct. 6th, lat. 35°, lon. 73°, [105 miles L.,] experienced a severe gale from N. E.; shifted the cargo, lost spars, &c.

94. Ship *Europe*, lost sails, &c., Oct. 6th, in a hurricane from E. S. E., [E. N. E. ?] in lat. 35° 25′, lon. 73°. [118 miles L. There seems to be an error here, either in direction of wind or locality, when compared with the other observations.]

95. Barque *Montpelier*, Oct. 5th, wind W., 8 P. M. wind N.; Oct. 6th, wind N., light breezes; 4 A. M. wind increasing from N. E.; at 7 A. M. took in jib and mainsail—wind not stated; 9 A. M. double reefed the topsails; noon, wind E., took in foresail and close reefed the topsails, heavy gale and rough sea; 4 P. M. took in fore-topsail and hove to with head to southward; 5 P. M. took in main-topsail; 6 P. M. wind N. N. E.; 7 P. M. cut away the topmasts, vessel lying rail under and would not right; 10 P. M. wind N. N. W.; 11 P. M. gale abating. Oct. 7th, moderate breeze from N. N. W. and a heavy sea; noon, lat. 35° 50′, lon. 72° 15′, [about 108 miles L.]

96. Brig *John R. Gardner*, left New York Oct. 4th, with westerly winds, which on night of 5th hauled to N. N. E. and increased, the vessel scudding before it, till it became one of the most terrible hurricanes that ever swept over the Gulf Stream. [Direction at height of gale not given.] We were now, Oct. 6th, in about lat. 35° 25′, lon. 73° 30′, [about 140 miles L.,] when the vessel broached to and lay on her beam ends; cut away mainmast, with which went the head of foremast, when she righted. Completed the voyage to Honduras under jury masts.

Capt. Good, who was then mate of the *J. R. G.*, informs me that the gale commenced at N. E., and that in its last stages it veered to N. and N. N. W.

97. Fort Monroe, near Norfolk, Va., lat. 37°, lon. 77° 40′, [345 miles L.] average of barometer, Oct. 1st, 30·57; 2d, 30·465; 3d. 30·129; 4th, 29·844; 5th, 30·052. On the 6th, A. M. 30·014, P. M. 29·842; 7th, 30·187. Winds, 1st to 5th moderate; 6th, A. M. E. N. E. and N. E. 3, P. M. N. E. 6, 9 P. M. N. W. 2. No rain reported in the seven days. [These observations indicate the presence of the gale in some strength on the 6th, and the barometric depression on the 4th appears connected with the advance of the first Cuba storm.]

98. Fort Severn, Annapolis, Md., Oct. 6th, winds N. E., 2 to 4, [440 miles L.]

99. Fort McHenry, Baltimore, Md., [465 miles L.] Oct 6th, winds N. 1; N. E. 3; N. E. 4; E. 1.

100. Schr. *Orozimbo*, left Delaware bay for Boston on the evening of Oct. 5th, wind W. N. W.; 9 P. M. Cape Henlopen bore W.; before midnight wind hauled to N. N. E. Oct. 6th, at daylight wind N. E., cloudy, breeze increasing; 11 A. M. near Five Fathom Bank, reefed topsails and mainsail; noon, 25 or 30 miles E. by S., or E. S. E., of Cape May, wind N. E., increasing; 3 P. M. took in topsail; 5 P. M. blowing heavy gale from N. E., took bonnet off jib, three reefed and handed the mainsail, and hove to under foresail; 11 P. M. lost boat from the davits; from midnight gale moderating and veering northward. Oct. 7th, at daylight wind N. N. W., more moderate, set three reefed mainsail and head of jib; noon, strong breezes N. N. W. and cloudy. [About 320 miles L.]

101. At Lewes, Del. [south shore Delaware bay, 360 miles L.] there was "a strong N. E. gale."

102. Fort Mifflin, Delaware river, lat. 39° 51′, lon. 75° 12′, [408 miles L.] There was no rain nor gale, but a strong breeze on the night of 6th from N. E. Oct. 6th, sunrise, wind N. E. 1; 9 A. M. N. 1; 3 P. M. N. 3; 9 P. M. N. E. 4. Oct. 7th, sunrise, N. 1; day, N. W. 1.

103. Ship *Orleans*, near to the coast of New Jersey, between Egg Harbor and Sandy Hook, [about 350 miles L.,] had the hardest of the gale on the night of Oct. 6th, from N. E. to N. W.; was reduced to three reefed topsails for three hours, in carrying sail upon the wind.

104. Barque *Washington*, sailed from Thomaston, Me. for St. Kitts, Oct. 3d. On the 6th, in lat. 37° 55′, lon. 70° 43′, encountered a severe gale from N. E. to E. S. E.; lost topsails and deck load, stove bulwarks, &c. [128 miles L. In this case, as in 91, the report of the hurricane-wind seems to have been taken down by the news collectors without regard to the order of time. On collating the surrounding observations, it appears certain that the E. S. E. wind preceded that from E. N. E. As frequently happens, the direction of the later part of the gale is not mentioned.]

105. Schr. *St. Pierre*, encountered the gale Oct. 6th, in lat. 37°, lon. 69° 36′, [56 miles L.,] which commenced from E. S. E. at 4 P. M., and lasted 14 hours, during which it changed to N. W.

106. At New York, lat. 40° 42′ 40″, lon. 74° 01′, 400 miles L. of axis line; Oct. 1st, 10 A. M. barometer 30·53; during the day winds light, chiefly from S.; cirrous clouds from W.

N. W., cloudiness 0 to 5. Oct 2d, 10 A. M. barometer 30·49; winds E. N. E. to S. 2; cloudiness 10 to 4; upper clouds (cirri) from W. S. W. and W., lower do. (cum.) from S. Oct. 3d, 10 A. M. barometer 30·17, 10 P. M. 29·94; winds chiefly S. S. E. 2 and 3; upper clouds (cir. strat.) from S. W., lower do. (cum.) from S. S. E., cloudiness 4 to 9; slight rain in the night. Oct. 4th, 7 A. M., barometer 29·75, 6 P. M. 29·66, 10 P. M. 29·69; winds N. N. E., W. S. W. and W., 2 and 3; cloudiness, A. M., 10 to 4, being cum. strat. from S. W; P. M. cloudiness 10 to 0, upper clouds from S. W., lower from W. by S. Oct. 5th, barometer 29·78, to 29·99; winds W. to N. W., 4–3; cloudiness 0 to 1, being scattered cumuli from N. W.

Oct. 6th, 7 A. M., barometer 30·05, winds N. N. W. 2, clouds (cum. strat.) from S. W. cloudiness 9 with a clear horizon at N. W.; 10 A. M. barometer 30·06; winds (to 2 P. M.) N. by W. to N. E., 2; clouds, cum. strat. from S. W., cloudiness 8, still clear at N. W.; 2 P. M. barometer 29·96; wind N. N. E., 3; upper clouds from S. W., as before, with a lower stratum of cumulus or storm scud flying from N. E. with increasing speed, cloudiness 9½ or 10, with a bright streak or band still at N. W.; 6 P. M. barometer 29·90; wind and clouds much as before; 10 P. M. barometer 29·84; winds and clouds without visible alteration. The observer's position is on the west side of the city, and it is probable that the force of wind on the *east* side, at 6 and 10 P. M. was 4 to 6. Strength of wind in the night greater, but not known. Oct. 7th, 7 A. M. barometer 30·02, wind N. by W. 3; upper clouds (stratus) from S. W., lower clouds (cum.) from N. by W., cloudiness 9½, with open horizon at W. N. W.; 10 A. M. barometer 30·05, winds N. N. W., 4; upper clouds from S. W., lower clouds from N. N. W., cloudiness 6 and clearness in the N. W. greatly enlarged; 2 P. M. barometer 30·06; winds N. W. 3, with cum. clouds flying from W. N. W., cloudiness P. M. 9 to 6; 10 P. M. barometer 30·18; winds N. W. 3; cum. clouds from W. N. W., cloudiness 2.*

The value of observations near the border of the *gale*, and through its whole barometrical period, may justify this last recital. No rain was noticed at New York, on the night of the 6th, but at Jamaica, L. I., eleven miles east, the rain-gauge showed 0·06 in., which probably marks the boundary of rain on this side of the gale. At Goshen, N. Y., and other places in the great valley of the Blue Ridge, which ranges about forty miles N. W. of New York city, the weather continued "fair" during both the 6th and 7th of October, winds chiefly northeasterly.

107. At North Salem, N.Y., lat. 41° 20′, [389 miles L.,] Oct. 6th, winds N. rainy in night.

108. At West Point, on the Hudson, lat. 41° 23½′, lon. 74°, [427 miles L.,] Oct. 6th, A. M. winds N. W., 1; P. M. N., 2; 10 P. M. N, 3. No rain. Oct. 7th, winds N. A. M.; N. W. P. M.

109. At New Haven, Ct., lat. 41° 18′, lon. 72° 57′, [380 miles L.,] Oct. 2d. A. M. bar. 30·40, winds N. W. and N. E., 1; P. M. bar. 30·30, winds S. E., 1, 2. Oct. 3d, half past 6 A. M. bar. 30·10; 9 P. M. 29·89; winds A. M. S. E., 2, 4; P. M. E. S. E., 4, rainy. Oct. 4th, A. M. bar. 29·70, 29·63, winds E. S. E., 6, S. W. by W., 3, rainy; P. M. bar. 29·58, 29·56, winds N. W. to S. W., 1. Oct. 5th, bar. 29·60, 29·86, winds W. and W. by N. Oct. 6th, A. M. bar. 29·92, winds N., 3; P. M. winds N. by E., 2; 9 P. M. bar. 29·72, wind N. E., 4; some rain in night. Oct. 7th, half past 6 A. M. drizzling rain, bar. 29·80, wind N. by W.; P. M. N. W.; 9 P. M. N. W., bar. 30·02.

110. At Fort Trumbull, Ct., lat. 41° 20′, lon. 72° 08′, [359 miles L.,] Oct. 6th, A. M. wind W., 1, N. W., 2; P. M. N. E., 3; 10 P. M. N. E., 5. Oct. 7th, A. M. N., 2, 3; P. M. W. 3. Rain, from 9h. 30m. P. M. of 6th to 10 A. M. of 7th, 0·57 in.

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* The facts in this report are from my own journal. The scale of *cloudiness* is from 0 to 10, the latter indicating the total obscuration of the horizon. Scale of winds, 0 to 12.

111. Ship *Hottinguer*, for New York, Oct. 6th, noon, lat. 40°, lon. 70°. Had the gale from N. E., veering by N.; carried light sails till dark, in lon. 71½°, running 10 knots. At 8 P. M. close-reefed topsails, furled mainsail, jib, spanker, and mizen-topsail, and run before the gale. Oct. 7th, at 8 A. M. moderate, out reefs and made sail; lat. at noon 39° 17′, lon. 73°. [At height of gale, about 265 miles L.]

112. Ship *Isabella*, Oct. 6th, it commenced blowing hard from N. E. at 6 P. M., and blew very hard for five hours, from N. E. to N. N. W., ending at N. W. Lat. 40° 30′, lon. 72°. [306 miles L.]

113. Ship *Columbiana*, experienced the gale on the night of the 6th, lat. 39° 40′, lon. 70°. [185 miles L.] Lost fore-topmast, and otherwise disabled; had all sails furled at the time.

114. At Fort Adams, R. I., lat. 41° 28′, lon. 71° 23′, [324 miles L. of axis line,] Oct. 1st, av. of bar. 30·401; Oct. 2d, 30·439; Oct. 3d, 30·143, A. M. wind S. E. and S., 3; P. M. S. E., 3, 4, rain from half past 1 P. M. Oct. 4th, bar. 29·784 to 29·595, wind S., 3, E., 4, heavy rain till noon, (2·1 inches,) clearing up with a sudden change from S. E. to W.; P. M. wind S. W. and N. W., 3. [This shows distinctly the first Cuba gale.] Oct. 5th, bar. 29·682 to 29·843, winds W., 4, 5; 10 P. M. W. 3. Oct. 6th, bar. A. M. 29·921, 29·984; P. M. 29·945, 29·972, winds A. M. N. W., 3, 2; P. M. S. E., 1, N. E., 5; heavy rain with high wind in the night; (rain 1 in.) Oct. 7th, bar. 29·776 to 30 in.; wind A. M. N., 5, 4; P. M. N. W., 3, 2.

115.* At Amherst College, Mass., [lat. 42° 22′, lon. 72° 28′, about 412 miles L.] Oct. 2d, bar. 30·15, 30·03, winds S. and S. W., 1, 2. Oct. 3d, bar. 29·91, 29·78, winds S. E., 1, 3, very rainy night. Oct. 4th, bar. 29·52, 29·30, winds E., 1, S., 2, S. W., 1, rainy morning. Oct. 5th, bar. 29·31, 29·51, winds S. E., 1, N. W., 3, 2, blustering. Oct. 6th, bar. 29·70, winds S. E., 1, N. by W., 2; clouds, stratus from S. W.; P. M. from N. E.; [probably lower scud clouds;] fair—lowering and chilly. Oct. 7th, bar. 29·60, 29·78; a little sprinkle in morning; cloudy and chilly day; winds, sun r., N. by W., N. W.; fair at 6 P. M.; 8th, bar. 29·90, winds N. W. and W., 1; fair, fine.

116. State Lunatic Hospital, Worcester, Mass, elevation 483 feet, lat. 42° 16′, [lon. 71° 47′, 376 miles L.] Oct. 2d, bar. *sunrise* 29·83, *sunset* 29·74, winds S. W., fair. Oct. 3d, bar. 29·59, 29·45; winds S. W., S. E., fair, cloudy, rain from 3 P. M., 0·83 in. Oct. 4th, bar. 29·18, 29·93, winds S. E., N. W., S. W.; rain 1·66 in., fair, cloudy. Oct. 5th, bar. 28·95, 29·13, winds S. W., N. W., fair, cloudy. Oct. 6th, bar. 29·35, 29·30, winds W. and N. W., fair, cloudy. Oct. 7th, bar. 29·19, 29·40, winds N. W.; raining at sunrise, (0·21 in.) cloudy.

117. In the Vineyard Sound, S. coast of Mass., lat. 41° 27′, lon. noon, 70° 45′, [300 miles L.,] the Schrs. *Henry* and *Cambridge* were dismasted at their anchors, in the gale from N. E., on the night of Oct. 6th.

118.† At Nantucket, lat. 41° 15′, lon. 70° 06′, [260 miles L.,] Oct. 4th, bar. 29·55, 29·50; winds S. E., 2, S. W., 1, cloudy and showers, fair. Oct. 5th, bar. 29·56, 29·53; winds W. S. W. 3, 2, clear. Oct. 6th, 9 A. M. bar. 29·85, wind N., 1, fair, slightly overcast with cirri; 3 P. M. bar. 29·85, E., 1, cloudy, grows thick and looks threatening, wind increasing; 6 P. M. bar. 29·80, N. E., 2, cloudy, every indication of a storm; 8 P. M. bar. 29·66, N. E., 3, rain, wind increasing; 10 P. M. bar. 29·60, N. E., 4, rain, gale increasing; 12 P. M. bar. 29·50, wind 6, and rain, gale extremely heavy. Oct. 7th, 9 A. M. bar. 29·70, wind N. N. W., 4½, slight rain; (whole rain 1·59 in.;) 3 P. M. bar. 29·80, N. N. W., 2, clearing. Oct. 8th, 9 A. M. bar. 30·04, wind N. N. W., and N. W., 1, weather delightful.

119. Schr. *Mogul*, Oct. 6th, 7th, lat. 40° 35′, lon. 69° 09′, [195 miles L.,] took a heavy gale from eastward, which blew a hurricane for about 4 hours; split balance reefed mainsail, was hove on beam ends and dismasted.

120*a*. Ship *Unicorn*, from Boston for New Orleans, Oct. 5th, at 9 A. M. got under way, with a fine breeze from W. S. W. and pleasant; at 10·30 A. M. Boston light-house bore N. W. by N. by compass, 2 miles. Noon, fresh breezes and passing clouds, course

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* Observations of Prof. SNELL, scale of strength of wind 0 to 6. The storm of 6th, 7th appears hardly to have reached Amherst, as regards the surface wind.

† WILLIAM MITCHELL's observations; scale of wind's force 0 to 6.

E. S. E., wind W. S. W.; 3 P. M. Cape Cod light-house bore S. W. ½ S., distant 5 miles; night, wind moderate.

Oct. 6th, begins moderate; 5 A. M. wind W. N. W., course S. by E. ½ E., set studding-sails. Noon, moderate and cloudy, lat. (D. R.) 40° 34′, lon. 69° 6′. P. M. commences light breezes from E. N. E. and cloudy; took in studding-sails and braced on larboard tack, course S. by E.; 4 P. M. wind freshening, took in m. royal and miz. top gt. sail; 6 P. M. in fore and main top gt. sail, sent down m. royal yard and close-reefed the mizen-topsail; 6·30 P. M. gale suddenly increasing, took in jib, spanker, fore and main-courses and mizen-topsail; 7 P. M. gale N. E.; 8 P. M. close-reefed fore and mizen-topsails. At 9 P. M. it was a complete hurricane, blowing the topsails to pieces before we could get them in; also blew the jib from the boom and the staysail from the hanks. At 11 P. M. a heavy sea making and ship rolling heavily, lost quarter boat and shifted the ballast; hove the ship to, head to southeastward. [Midnight, lat. computed, 39° 47′, lon. 68° 56′.]

Oct. 7th, wind commences hauling towards N. W. and blowing a hurricane with a heavy cross sea, ship hove to under a tarpaulin in the mizen rigging; tried to bend mizen-staysail, but found it impossible; forenoon more moderate; at 10 A. M. kept off S.; set reefed courses, bent and set staysails. [Noon, computed lat. 39° 33′, lon. 69° 3′.] P. M. commences with wind settling at N. W.; unbent fragments of topsails, bent new ones and set them double-reefed; course S. by W. Night more moderate; made sail accordingly. [Next 12 hours pleasant, wind W.]

120 *b*. Brig *Corvo*, took the gale at 11 P. M. of the 6th, in lat. 39° 40′, lon. 68°; was on her beam ends two hours; main-topsail and foresail blown away when furled snug in the yards. [103 miles L. of axis line.]

121. Ship *Sarah & Arsilia*, for Havre, Oct. 6, A. M., moderate; noon, heavy rain in squalls from S., lat. D. R. 39° 20′, lon. D. R. 67° 38′; [103 miles L.;] P. M. begins wind S. E.; at 2 P. M. freshening, double-reefed the topsails; 4 P. M. blowing a gale from E. S. E., close-reefed the topsails and reefed the foresail; at 7 P. M. the gale had veered to E. N. E., and at 8 P. M. hove the ship to, blowing violently; at 11 P. M. blowing a hurricane. Oct. 7th, at 2 A. M. the hurricane shifted rather suddenly to N. E.; at 2·30, shipped a heavy sea, stove bulwarks, &c.; [(?) 50 miles L.;] 8 A. M. gale still heavy from N. E.; 10 A. M. N. N. E., commenced scudding; at 1 P. M. wind had veered to N. W., strong gales and clear weather with a high sea, set close-reefed fore-topsail and reefed foresail; 6 P. M. more moderate, shook out one reef; midnight, still moderating, set top gt. sails over single reefs. Oct. 8th, moderate breezes from W. N. W., lat. 40° 34′, lon. D. R. 64° 32′. [12 miles L. This vessel was in the Gulf Stream, which, with her general course eastward, prolonged the duration of the gale.]

122. Ship *Zurich*, Oct. 6th, lat. 40° 27′, lon. near 67°, [140 miles L.,] calm; 2 P. M. N. E., moderate; 4 P. M. E., freshening; 8 P. M. gale N. E., scudding, double-reefed top-sails, took in jib and mainsail. Oct. 7th, 3 A. M. gale still increasing, split the foresail; 4 A. M. hove to; 8 A. M. gale had veered to N. W.; 11 A. M. bent a new foresail and made sail, winds more moderate with heavy sea; noon, lat 39° 30′, lon. 68° 30′, [115 miles L.]

123. Ship *Courier*, for Gibraltar, Oct. 6th, A. M. wind W. to E. N. E., light, lat. 39° 43′, lon. 67° 19′, [80 miles L.] P. M. commences with fresh gales from E. N. E.; 2 P. M. in top gt. sails; 3 P. M. double-reefed the topsails; 4 P. M. close-reefed, gale still increasing, course S. E. by S. upon the wind; 6 P. M. reefed the foresail and hove to; heavy sea breaking over the ship; latter part heading E., gale having veered to N. E. and N. N. E. and increased to a full hurricane. [(?) 40 miles L.] Oct. 7th, a tremendous hurricane; at 4 A. M. wind was N. W. with rain, having hauled from N. E. during the night; 8 A. M. gale abating; 10 A. M. bore away and set reefed foresail, a heavy sea on; noon, lat. 39° 25′, lon. 66° 25′, [29 miles L.] At 1 P. M. gale N. W., set mainsail; 5 P. M. out one reef of main-topsail; 8 P. M. set jib and spanker, blowing in squalls, with a heavy sea; latter part moderate. At 2 A. M. Oct. 8th, out reefs and set topsails.

124. Ship *Nathaniel Hooper*, sailed from Boston Oct. 5th; noon of 6th, lat. obs. 40° 58′, lon. (chr.) 68° 21′, calm; P. M. course S. W., winds N. E., increasing; 5 P. M. in all light sails; 7 P. M. wind increasing to a gale, shortened sail and close-reefed topsail; 10·30 P. M. gale increasing, with rain in torrents, took in mizen-topsail, and while handing fore-top-

sail gale increased to a tornado and caused the ship to broach to; it blowing a perfect hurricane which tore all the sails into ribbons, blowing them from the gaskets; a tremendous sea, occasionally breaking over the ship. Oct. 7th, [about 152 miles L.,] blowing a hurricane, ship lying to; up N. E., off E.; at 11 A. M. gale abating, still lying to, with a N. N. W. gale; at noon wore ship to S. W.; lat. (D. R.) 39° 51′, lon. 68° 48′; P. M. strong gales N. N. W. and cloudy; ends with light winds from N. W. Oct. 8th, noon, lat. 38° 44′, lon. (chr.) 69° 35′. Capt. CHURCHILL states that his barometer fell to 28·40, [add index error ·20=28·60,] and that three of the ships which left Boston in company with the *N. H.* returned to port dismasted.

125. In Boston Bay [about 318 miles L.] the gale was severe at N. E., and several vessels were driven on shore during the night of the 6th, near Point Alderton, at Scituate, &c.

126. Watertown Arsenal, Mass., lat. 41° 21′, lon. 71° 12′, [352 miles L.,] Oct. 3d, winds S. E., 2; 9 P. M. S. E., 3, and clouds from S. E. Oct. 4th, A. M. S. E.; 3 P. M. S. W., 2; 9 P. M. N. W. 2; (rain from 3 P. M. 3d, to 1 P. M. 4th.) Oct. 5th, sunrise, W., 2; 9 A. M. S. W., 3; 3 P. M. S. W., 5; 9 P. M. N. W., 1. Oct. 6th, A. M. W., 2; 3 P. M. N., 2; 9 P. M. N. E., 3. Oct. 7th, sunrise, N. E., 1; 9 A. M. N. W., 2; 3 P. M. W., 1; 9 P. M. N. W., 2; rain from 10 P. M. 6th to quarter past 1 P. M. 7th, 0·74 in.

To this may be added the following barometrical observations of R. T. PAINE, Esq., at Boston, made at sunrise, half past 2 P. M., and 10 P. M. Oct. 1st, 30·23, 30·37, 30·38. Oct. 2d, 30·40, 30·30, 30·34; 3d, 30·24, 30·08, 29·96; 4th, 29·80, 29·47, 29·48; 5th, 29·48, 29·60, 29·79; 6th, 29·92, 29·90, 29·79; 7th, 29·82, 29·86, 30·03; 8th, 30·05, 30·05, 30·06.

127. Fort Constitution, Portsmouth, N. H., lat. 43° 03½′, lon. 70° 43, [364 miles L.,] Oct. 6th, A. M. winds N., 2, N. W., 1, halo; P. M. E., 2, N. E., 5. Oct. 7th, winds N., 3; rain 0·38 in.

At Saco, Me., about 30 miles N. of Portsmouth, the barometrical observations of J. M. BATCHELDER, taken at 7 A. M., 2 P. M., and 7 P. M., at 65 feet above high water, were as follows, viz.—Oct. 1st, 30·31, 30·32, 30·37. Oct. 2d, 30·39, 30·26, 30·34; 3d, 30·32, 30·17, 30·12; 4th, 29·84, 29·59, 29·57; 5th, 29·56, 29·56, 30·14; 6th, 29·93, 29·96, 29·97; 7th, 29·86, 29·93, 29·94; 8th, 30·06, 30·07, 30·04.

128. At Hanover, N. H., on the Connecticut, lat. 43° 41′, lon. 72° 22′, [460 miles L.,] Oct. 2d, bar. 30·08 to 29·88, winds N. W., S. W., S. E. Oct. 3d, bar. 29·76, 29·60, winds S. E., rain from 8 P. M. Oct. 4th, bar. 29·40, 29·11, winds S. E. at sunrise, S. W. at half past 1 and half past 9 P. M., (rain to 3 P. M., in all 2·85 in.) Oct. 5th, bar. 29·10, 29·44, winds S. W., N. W., (bar. 29·09 at 9 A. M. and sprinkling of rain 10 A. M.) Oct. 6th, bar. 29·59, 29·52, winds N. W.; N. at half past 9 P. M. 7th, sunrise, bar. 29·45, half past 1 P. M. 29·59, half past 9 P. M. 29·71, winds N., rain from 3 P. M. 0·02 in. Oct. 8th, A. M. bar. 29·70, 29·72, winds N.; half past 9 P. M. winds S. W., barometer falling. [From these observations of Prof. YOUNG and those of Prof. SNELL at Amherst, it appears that the strength of this second storm, as one either of wind or rain, did not reach the valley of the Connecticut, although barometrically, its influence was more widely extended.]

129. Ship *Mediator*, for London, Oct. 6th, noon, lat. obs. 40° 20′, lon. (chr.) 65° 36′, [40 miles L.,] wind N. E.; commenced blowing at 2 P. M.; at 4 P. M. blowing hard; 6 P. M. under close-reefed topsails; 10 P. M. very heavy gale, hove the ship to, with head still to southward; midnight, wind E. S. E. Oct. 7th, commences with gale still increasing; 3 A. M. wind had hauled to S. E.; [ship now near the axis line of the gale;] 4 A. M. gale, S. S. W.; 6 A. M. gale S. W. by W., still blowing hard; 8 A. M. wind W.; 9 A. M. N. W. by N.; 11 A. M. N. W., and continued to blow in that quarter; noon, lat. 40° 32′, lon. 61° 36′. [98 miles R. of axis line; having crossed the same during the gale. This accounts for the veering of the wind by the S., as the gale passed over, instead of by the N. as on the L. side.] Capt. CHADWICK states that his barometer fell as low as 28·20, of which he is certain, and he thinks lower, previously to 4 A. M. [This barometer reads 0·08 in. lower than my own, giving 28·28 in. for the above observation.]

130. Ship *St. Nicholas*, for Havre, Oct. 6th, lat. 40° 30′, lon. 66° 20′, wind E., cloudy, course S. S. E.; 5 P. M. [25 miles L.] commences blowing strong from E. N. E. with rain; 6 P. M. double-reefed; 7 P. M. in fore and main-topsail and mainsail; 8 P. M. blows tremendously, hove the ship to under close-reefed main-topsail, head S. S. E., [wind about

E.;] 11 P. M. gale S. E. Oct. 7th, at 2 A. M. wore ship to N. E.; about 3 P. M. *wind abated at S. E. and came out light from N. W.*, which suddenly increased to a tremendous gale; hove the ship to, sea running high from the old quarters and making a clear breach over the ship; 8 A. M. kept away before the wind; noon, weather moderated and all sail set, lat. 39° 40′, lon. 64° 45′, [31 miles R.] Oct. 8th, lat. 40° 40′, lon. 62° 40′, Capt. PELL states that between 1 and 4 A. M. his barometer had fallen to or below 28·20; the lowest he had seen it, except in the gale in which the steam-ship *President* was lost. [Its error being 0·17 in. gives 28·37 in., corrected.]

The *Cambridge*, for Liverpool, was in company with the *Mediator* before the gale, and in like manner with that ship and the *St. Nicholas*, crossed the axis line during the gale and had the wind veer by the South, as follows:

131. Ship *Cambridge*, Oct. 6, P. M., wind freshening from E. N. E., veering to E. S. E., ship's course S. E. to S.; at 4 P. M. topsails were double reefed; 6 P. M. close reefed; furled foresail; gale increasing. October 7th begins by wearing ship to the E. under close reefed main-topsail and main spenser; wind increasing; at 2 A. M. a complete hurricane; blew away the main-topsail; wind hauling gradually from S. S. E. to westward; at 7 A. M. bore away* under close reefed fore-topsail; 10 A. M. set the foresail; at 6 P. M. more moderate. The mate states that the wind hauled gradually from S. S. E. to S. W. and the westward.

132. Brig *Mentor*, for Guadaloupe, Oct. 6, lat. 40° 30′, lon. 65°, [24 miles R.] light winds from N. and E. and heavy sea. Towards evening wind increased, and before 10 P. M. a heavy gale set in blowing from S. E.; 11 P. M. hove to. October 7th, gale increasing, and before 4 A. M. blew a hurricane; by 6 A. M. every mast and spar was blown from the wreck.

133. Ship *Roscius*, for New York, took the gale off N. E. end of George's Shoal, near lat. 41° 10′, lon. 65° 50′, [about 85 miles L.] on the 6th, about 6 or 7 P. M., from E. N. E. The gale was heaviest about 1 A. M. of the 7th, when the barometer stood somewhat below 28 inches, but soon rose, and the gale veered suddenly to N., and thence gradually to the northwestward. At the commencement of the gale on the evening of the 6th, the barometer stood at about 29·70. [Its index error, I am told, was two or three tenths; corrected minimum, say 28·25 inches.]

134. Ship *Rochester*, Oct. 7th, lat. 42°, lon. 67°, [182 miles L.] experienced a severe gale from N. E.; lost main-topsail, foresail, &c., and sprung fore and main masts.

135*a*. Fort Preble, near Portland, Me., lat. 43° 30′, lon. 70° 20½′, [368 miles L.] Oct. 2d, average of barometer, 30·249; Oct. 3d, 30·155; Oct. 4th, 29·739, wind S. E., 6 to 8, rain from 7 P. M. of 3d to 4 P. M. of 4th, 0·90 inches; Oct. 5th, bar. 29.535, 9 P. M. 29·717, winds, A. M., S. W., 3, 4; P. M., W., 6, 4, 1. Oct. 6th, sunrise, bar. 29.937, wind S. W., 2; 9 A. M. bar. 30·059, wind S. W., 1; 3 P. M. bar. 30·055, wind S. W., 1; 9 P. M. bar. 29·977, wind, S. E. (?) 6. Oct. 7th, sunrise, bar. 29·736, wind N., 6; 9 A. M. bar. 29·862, wind N. W., 4; 3 P. M. bar. 29·961, wind N., 4; 9 P. M. bar. 30·032, wind N. E., 1; light rain 7th, from 6 A. M. to 6 P. M., 0·14 inches.

135*b*. The following observations were made at Hampden, Me., on the Penobscot River, 180 feet above tide, lat. 44° 42′, lon. 68° 56′. From journal of J. HERRICK.

Oct.	Barometer.				Ther.	Wind, and its force.†				Clouds, velocity and course from.			
	S. R.	9 A. M.	3 P. M.	9 P. M.	Mean.	S. R.	9 A. M.	3 P. M.	9 P. M.	S. R.	9 A. M.	3 P. M.	9 P. M.
2	30·24	30·29	30·24	30·40	68·75	N. W. 1	S. W. 1	S.S.E. 2	S.W. 2		Smoky	Hazy.	
3	30·26	30·23	30·10	30·10	67·75	S. E. 1	S. E. 2	S. E. 3	S. E. 2		S. E. 2	S. E. 3	S.S.E. 2
4	29·88	29·88	29·54	29·34	65·75	S.S.E. 6	S.S.E. 6	E. 6	E. 1	E. 6	S. E. 8	E. 8	
5	29·29	29·30	29·27	29·45	54·75	S. 1	S. 3	N. W. 5	W. 2		S. 3	N.W. 3	
6	29·80	29·83	29·83	29·84	49·75	S. W. 1	N. W. 2	N. W. 2	W. 1		N. W. 2	S. E. 3‡	
7	29·65	29·70	29·87	29·94	42·25	N. W. 6	N. W. 4	N. W. 3	N. 2	N. E. 6	N.N.E. 4	N.W. 3	W. 2
8	30	30·03	29·90	29·90	43·75	N. W. 1	S. W. 1	S. W. 1	S.W. 1	N.W. 1	N. W. 3	N.W. 2	N. W. 1

* The sea terms, "*bear up*" and "*bear away*," have but one meaning among our seamen. The latter term, though not accordant with authority, seems best to express the idea of sailing off from the wind; the former refers to the act by which the result is produced.

† Formulary of the Surgeon General's office. ‡ High current.

Oct. 4th, at 5 A. M., wet; frequent showers with violent wind in short gusts; continued to blow hard with slight rain to 11 A. M., when the storm commenced with great violence; from 11 A. M. to 8 P. M. there fell 0·95 inches of rain; 2 P. M. thunder shower N. W. Oct. 6th, high current from S. S. E. all day; low clouds from N. W. Oct. 7th, at 6 P. M. a pause; from 9 A. M. to 9 P. M. 0·54 inches of rain fell. During the progress of this storm [night of 6th and 7th] the low wind has been from N. W. with a rising barometer, and a higher current from S. S. E. [The lower or *scud cloud*, however, has shown here the true course of the wind in the *storm stratum*, and conformably to the barometric changes; see table. Both here and in Massachusetts, the old N. W. surface wind of the 5th appears to have intruded beneath the storm stratum, nearly or quite to the sea coast.]

136. At Yarmouth, Nova Scotia, lat. 43° 51′, lon. 66° 05′, [28 miles N. W. from Cape Sable, and 225 miles L.] a heavy gale commenced at 11 P. M. Oct. 6th, from N. E., and at 11 A. M. of the 7th, veered to N. W. Vessels in port damaged and driven on shore.

137. Ship *St. Petersburg*, Oct. 6th and 7th, Cape Sable N. W. 25 miles, [lat 43° 05′, lon. 65° 14′, about 152 miles L.] experienced a gale from E., lost topmasts and mainsail. [It must be inferred that this position, west of the ship's proper track, was at the close of the easterly part of the gale, and that the vessel was much nearer the axis line in the early part of the storm. Close of the gale not mentioned.]

138. Fort Sullivan, Eastport, Me., lat. 44° 53′, lon. 67°, [310 miles L.] Oct. 4th, winds E., 4, 5; 9 P. M., N. E., 6; 5th, S. E., 1, S. W., 3, 4, W., 2; rain from 1 P. M. of 4th, with high winds—rain, ending 2 A. M. of 5th, 2·10 inches. Oct. 6th, A. M., winds W. 2.; P. M., N. W., 1, 0. Oct. 7th, sunrise, wind N. E., 6; 9 A. M., N., 4; 3 P. M., N. W., 3; 9 P. M., N. W., 3; rain from 2 A. M. to 10 P. M., 0·55 inches.

139. At Hancock Barracks, Holton, Me., lat. 46° 5′, lon. 67° 40′, [390 miles L.] Oct. 2d, average of bar. 29·593: 3d, 29·68: 4th, A. M., 29·576, wind E., 4, 5; 2 P. M. 29·209, wind E., 6; 9 P. M. 29·075, wind E., 6; rain from 1½ P. M. ending in night, 0·54 inches: 5th, A. M., 28·862, wind S. E., 3, S., 4; P. M. 28·835, wind S., 5, 3, showery. Oct. 6th, sunrise, bar. 29·063, wind S. W., 3; 10 A. M. 29·099, wind N. W., 3; 2 P. M. 29·205, wind W., 2; 9 P. M. 29·205, W., 2: 7th, sunrise, 29·142, N. E. 4; 9 A. M. 29·177, N. E. 4; 2 P. M. 29·142, N. W., 3; 9 P. M. 29·236, N. W., 3; rain from 11 A. M. to 4 A. M. of 8th, 0·70 inches, [apparently within the range of the two storms.]

140. At Fort Kent, Me., lat. 47°? lon. 68° 20′? [about 460 miles L.] Oct. 4th, wind S. E., 1, 2; 5th, N. E., 1, 2, W. 2; rain from 3 P. M. of 4th to 11 A. M. of 5th, 0·84 inches; 6th, N. W., 3, 2, 1, showers in night, 0·03 inches. Oct. 7th, A. M., N. E., 2; 2 P. M., N., 2; 9 P. M., N., 1; rainy from 3 P. M. to 5 P. M., 0·02 inches. Aurora in the evening. [No gale here, but the more moderate influence of both storms is distinctly seen.]

141. H. M. ship *Illustrious*, Ad. Sir CHARLES ADAM, in Halifax harbor, lat. 44° 36′, lon. 63° 28′, [168 miles L.] Oct. 4th, A. M., (first 12 hours,) bar. 30·29 to 30·05; winds from E. S. E., 4, 5, c., to S. by E., 6, c. q.; P. M. bar. 30·01, to 29·80 at 10 P. M.; winds S. by E., 6, S. E., 7, E. S. E., 8, E. by S. 9, 7; rain from 6 P. M. Oct. 5th, bar. 2 A. M. 29·50; 10 A. M. 29·54, noon, 29·60; winds, 2 A. M., S. E., 5, o. c. q.; 4 A. M., W., c. o.; 6th A. M., S. W., 3, o. t.; 10 A. M., S. W., 2; 2 P. M. bar. 29·51, 10 P. M., 29·56; winds, W. S. W., 3, 4 o. c.; 6 P. M., S. W., 4, 2, c. Oct. 6th, A. M. bar. 29·59 to 29·75, P. M. 29·78 to 29·83; winds A. M., S. W., N. W., 3, 2, b. c., c. f.; P. M., N. W. to N. N. W., 3, 2; ends calm. Oct. 7th, bar. 2 A. M. 29·76; 4 A. m., 29·76; 6 A. M. 29·56; 8 A. M. 29·50; 10 A. M. 29·40; noon 29·23; 2 P. M. 29·38; 4 P. M. 29·38; 6 P. M. 29·40; 8 P. M. 29·43; 10 P. M. 29·59; 12 P. M. 29·73: winds, 2 A. M., N. Easterly, 4, c.; 4 A. M., N. E., 5, c. r.; 6 A. M., E. N. E., 6, q. r.; 8 A. M., E. N. E., 7, q. r.; 10 A. M., N. E., (northeasterly,) 8, q. r.; noon, N. Easterly, 8, q. r.; 2 P. M., N., 6, o. q. r; 4 P. M., N., 6, o. q. r.; 6 P. M., N. Westerly, 5, c. q., and the same to midnight. Oct. 8th, A. M., bar. 29·74 to 29·88; winds N. W., W. N. W., N. W., 6, 5, 2, 4, c. o., b. c.; P. M., bar. 29·88; winds W. N. W., 4, 2, 1. [According to the barometer, the axis of the gale appears to have been opposite to or S. E. of Halifax about noon of 7th, or soon after.]

142. H. M. ship *Scylla*, at and from Prince Edward's Island, Gulf of St. Lawrence, Oct. 2, A. M., winds N. W. to W. N. W., 4, c., bar. 30·20; P. M., running for Pictou and anchored under Pictou islands; winds W. N. W., S. W., 4, 3, 2. Oct. 3d, running for

Cape St. George; A. M., winds W., S. W., S., S. S. E., 2, b. c., bar. 30·40: P. M., winds S. by W., 3, S. S. E. and S. E., 4, b. c.; anchored under shelter of Cape St. George. Oct. 4th, weighed for Gut of Canso; 2 A. M., winds S. E. by S., 5, 6, b. c.; 6 A. M., S. E. by E., 6, 7, b. c. q.; 11 A. M., S. E., 6, b. c.; bar. 30·20: P. M., winds S. S. E., 7, c. g. q.; 5 P. M., S. S. E., 7; ends S. S. E., 7, c. g. r.; strong gales and heavy rain. Oct. 5th—for and in Gut of Canso; 1 A. M., winds S. E. by S., 8, c. q. r.; 4 A. M., S. S. E., 6, q.; 6 A. M., S., 5, c. b.; 8 A. M. S. W. 4, b. c.; noon, W. by S., 3, bar. 29·30: P. M. winds W., 1 to 5, b. c.; anchored in Ship Harbor, Gut of Canso. Oct. 6th, A. M., winds W., 2, 5, bar. 29·75: P. M., winds W., 4, 3, 2; calm, easterly, 2, b. c.; ends off Cape Canso.

Oct. 7th, running from Cape Canso for Halifax, wind easterly, 4, b. c.; lost sight of light at 1·15 A. M.; 4 A. M. wind 6, b. c.–c. r.; at 6·30 double reefed fore and three reefed main-topsail; 6 A. M., E. by N., 6—9, o. r. c.; at 9·30 furled topsail, down top-gallant yards and housed top-gallant masts; 10 A. M., gale 10, q. r. c.; at 11 gale E. N. E., 10; hove to on larboard tack; course from 4 to 11, W., 8 to 11 knots; noon, gale 10; bar. 28·90; Sambro Light, N. 82, W. 25 miles. [Lat. 44° 21′, lon. 63°, 132 miles L. The westward run from off Cape Canso increased the distance from the axis line, and appears to have produced a change of one or two points in the direction of the gale.] P. M., lying to, struck mizen-topmast; 2 P. M., gale N. E., 9, o. g. r.; 4 P. M., 9, 8, o. g. r.; 6 P. M., N. W. by N., 8, o. g.; from 9 to 12, N. W. by W., 8, 7, o. g. Oct. 8th, A. M., winds N. W., 6, 6, 5, W. N. W., 4, c. g., c.; at 5 A. M. began to make sail; noon, bar. 29·90: P. M., winds W. N. W. to W., 4, 3, 4, b. c.; ends with Sambro Light 8 miles distant.

143. Schr. *Actress*, in Little Canso Harbor, S. E. point of Nova Scotia, lat. 45° 20′, lon. 60° 58′, [about 98 miles L.] gale commenced nearly at S. E., and after blowing near 12 hours hauled steadily by the N. to N. W.

144. H. M. ship *Pique*, Capt. M. Stopford, Gulf of St. Lawrence, Oct. 6th, 4 A. M., bar. 29·36, wind N. W. by N. 4; noon, lat. 47° 59′, lon. 63° 18′, bar. 29·65, winds N. W. by N., 5; 3 P. M., W., 4, b. c., bar. 29·75; 8 P. M., N. W., 4, bar. 29·90; 10 P. M., N. E., 2; midnight, E., 3. Oct. 7th, 3 A. M., wind E. by S.; daylight, land of Cape Breton Island on the weather bow; 7·20 A. M., single reefed; 8 A. M. bar. 29·63, wind S. E. by E. (magnetic) 5, c. r. m.; 9. A. M., bar. 29·54; in top-gallant sails, close reefed the spanker, down jib; 9·30, island of Justicoe bore E. S. E. one mile, in 2d reefs; 10·30, tacked; run for and at 11 A. M. anchored under the island, wind E. by N. 7, c. r. g.; [Justicoe, or Just au Corps, is in lat. 46°, lon. 61° 37′, about 135 miles L.] noon, bar. 29·40; 1 P. M., wind E. N. E., 7, o. g. r. f; bar. 29·29; 2·15 P. M., wind 8, weighed anchor and run for Gut of Canso under courses, staysail, and close reefed spanker; 3 P. M., bar. 29·19, wind N. E., 10, o. m. d. q.; [at or near crisis of gale, about 120 miles L.] 3·15, split and blew away part of the foresail; 4 P. M., wind N. E., 9, o. q., split main-staysail; 4·30, came to anchor 4 miles within the Gut of Canso, [say lat. 45° 39′, lon. 61° 23′, about 120 miles L.]; 5 P. M., bar. 29·29, wind N. E., 8, q. m.; 6 P. M., wind N., 7; 7 P. M., N., 6, c. q.; 8 P. M., N. by W.; 9 P. M., N. by W., 5, m., bar. 29·18; 10 P. M., N. W., 6, m. r. q.; midnight, N. W., 6, b. q. m. Oct. 8th, 2 A. M., wind N. by W., 5, c. q. r.; 4 A. M., bar. 29·77; 6 A. M., N. W., 6, c. q. r.; 8 A. M., W. N. W., 5, b. c. q., bar. 29·87, weighed anchor and made sail out of the Gut; 10·30, anchored in Inhabitants Bay [lat. 45° 34′, lon. 61° 16′;] noon, bar. 29·85, wind N. N. W., 5, b. c. q. r.; P. M., wind N. N. W. to W.

The *Pique* also encountered the gale of the 4th and 5th, in the St. Lawrence, but I have no copy of the log for this period.

145. Schr. *Normal*, sailed from the Labrador Coast, Oct. 6th, with a fresh breeze from N., bound for St. Johns, N. F. The wind freshened during the following night, and hauled to E. N. E. October 7th, it increased gradually to a gale from E. S. E. Could not weather Cape Bonavista, and having split the sails, bore away for shelter among the islands in the bay and repaired damages, [about lat. 48° 45′, lon. 53° 45′, 36 miles L.? Mag. var. about 25° W.] At this anchorage the gale is said to have changed by the N. to N. W.

Having thus followed the gale on the left side of its axis to the extent of our reports, we now resume the accounts from the right side of the storm, from Bermuda onward.

146. Ship *J. N. Cooper*, bound for Gulf of Mexico, Oct. 6th, about 1 P. M. the gale had commenced blowing hard from S. E. by E., which in hauling to S. S. E. increased to a furious hurricane, in which all the spars were blown off the ship except the lower masts. The wind had continued hauling to S. S. W., at which point the force of the hurricane began to abate, and the gale continued hauling to S. W. and thence to N. W., ending about midnight. The greatest force of the hurricane lasted about five hours. Position near the close of the hurricane lat. 35° 50′, lon. 69°, [25 miles right of axis line; ship further from this line in the earlier part of the gale.]

148. Brig *Wakulla*, for New York, Oct. 6th, 3 A. M. wind S. S. E., light, freshening in the forenoon, with clear weather; noon, lat. 35° 36′, lon. 66°, [148 miles R.:] P. M. begins with strong gales from S. S. E., took in light sails; 3 P. M. gale increasing, double-reefed topsails, barometer rapidly falling; 6 P. M. heavy gale, close-reefed topsails, took in mainsail and jib; 9 P. M. blowing a hurricane from S., took in fore-topsail and foresail, and hove to at 10 P. M. head to eastward. Oct. 7th, at 1 A. M. the vessel was forced on her beam ends, yards broke and sails blew to pieces, hurricane still blowing with inconceivable fury; soon after 2 A. M. it began to abate a little in its force, till at half past 3 A. M. it suddenly changed and came in its full strength from N. W., [20 miles R. (?)] In about 2 hours afterwards it began slowly to abate, so that at 8 A. M. we set a reefed foresail and close-reefed fore-topsail. The gale lasted till noon, when we observed in lat. 36° 41′, lon. 67° 30′. [47 miles R. At the change of the gale the vessel must have been further to the N. W.]

Near midnight on the 6th, Capt. MULFORD saw that his barometer had fallen to about 27·50. [Add adjustment error 0·15, and for assumed error of observation say 0·10=27·75 in.] The weather was not cloudy in the commencement of the gale, nor so long as the spray blown from the sea permitted observation. Nor at this time was the sea heavy, being blown off comparatively smooth by the violence of the wind, which blew with a force surpassing previous belief or conception.

149. Brig *St. Lawrence* was dismasted in a hurricane Oct. 6th, lat. 36° 50′, lon. 67° 2′. [65 miles R.]

150. Brig *Charles*, took the gale Oct. 6th, in lat. 37° 50′, lon. 67°, [35 miles R.,] was hove on beam ends, lost mainmast, fore-topmast, &c.

151. Barque *Elvira*, for Philadelphia, Oct. 6th, in lat. 38° 10′, lon. 66° 30′, [22 miles R.,] experienced a tremendous hurricane from S. to S. S. W. [This vessel was bound to the N. W., and the position is probably that of noon after the gale. Like the *Wakulla*, on the same course, she probably took the gale at a much greater distance from the axis line, and seems to have reported only the hurricane portion of the gale.]

152. Whaling ship *Nye*, for the Pacific Ocean, took the gale of Oct. 6th, in lat. 38° 58′, lon. 65°, [47 miles R.,] from S. E., with rain, lay to heading S. W.; 8 P. M. took in storm-staysail; gale increasing till 1 A. M. of Oct. 7th, when the ship became disabled, and sails blown in tatters; at 8 A. M. gale abated.

153. Whaling ship *Mt. Vernon*, for the Pacific, Oct. 6th, lat. 39°, lon. 66°, [6 miles R.:] 6 P. M. wind E., stormy indications; bar. fell and wind increased during the evening. From midnight till 4 A. M. of the 7th it blew a perfect hurricane, when it suddenly shifted to S. and S. W. and settled at W., blowing if possible harder than before; at 8 A. M. of the 7th it was moderate; lost all her masts and otherwise injured. [The sudden shift of the wind shows the ship to have been near the axis of the gale.]

It has been seen that three ships, cases 129 to 131, first took the gale on the left side of its axis path, and crossed the same in front of the axis, which brought them into the right side of the gale where it veered by the S. to the W. Our next three cases on this side, will be nearer the right border of the gale.

154. Brig *Lowell*, from Tobasco to Marseilles, Oct. 5th, lat. 33° 46′, lon. 64° 40′; P. M. good breeze from S. W., overcast; midnight, moderate breezes and passing clouds. Oct.

6th, 5 A. M. wind S., increasing; 9 A. M. veered to S. E. quarter, took in top gt. sails, brisk winds and clear weather; noon, lat. 34° 18′, lon. 62° 30′, [372 miles R.,] going 8½ knots. P. M. wind S., strong, with clear weather, all drawing sails set; 8 P. M. wind increasing, in top gt. sails; 9 P. M., wind S. S. W.; midnight, strong wind and clear weather, sea making fast and had caused the brig to spring a leak. Oct. 7th, 1 A. M. wind S. W., very strong; 1·30 A. M. split the jib and took in the topsail, wind blowing a gale, which continued till 7 A. M., [then about 443 miles R.,] when it began to moderate; wind S. W., set fore and main-topsails; noon, strong winds and passing clouds, lat. obs. 35° 33′, lon. 58° 40′, [462 miles R.] P. M. more moderate, with appearance of rain; 5 P. M. winds baffling, brig laboring heavily in a very high sea; 7 P. M. wind W.; 11 P. M. moderate, at W. N. W. and cloudy weather. [The full extent of the gale on this side, from the axis line, probably exceeded 500 miles.]

155. Barque *Wm. Engs*, for New York, Oct. 1st, lat. 37° 20′, lon. 48° 44′; P. M. brisk breeze from N. N. E. and squally. Oct. 2d, lat. 36° 47′, lon. 52° 30′, brisk breeze from N. N. E.; midnight, N. E. Oct. 3d, lat. 37° 01′, lon. 56° 30′; P. M. N. E., fair; 4 P. M. wind E.; midnight, E. S. E. Oct. 4th, A. M. wind hauling S. E.; noon, lat. 37° 21′, lon. 59° 51′; P. M. wind increasing; at 8 P. M. obliged us to double-reef; midnight, close-reefed, wind hauling gradually to S. with an unusual heavy sea from S. Oct. 5th, at 6 A. M. wind had hauled to S. W., and blew a smart gale of wind; carried storm spensers, close-reefed main-topsail and reefed foresail, by the wind; noon, lat. 37° 18′, lon. 60° 11′, blowing in squalls from S. W.; 4 P. M. more moderate, made sail; midnight, calm, and light airs from S. W.

Oct. 6th, noon, lat. 37° 10′, lon. 60° 29′, [316 miles R.,] winds S. W., fair; 8 P. M. strong from S. W., took in sail; midnight, heavy gales from S. W., with heavy sea from S. Oct. 7th, 3 A. M. gale so increased as to compel us to heave to, after which it gradually hauled to W. and N. W., blowing a heavy gale; P. M. gale continues with a heavy sea, had veered to W. N. W.; at 6 P. M. began to moderate, and at midnight fell calm.

156. Barque *Charleston*, for New York, Oct. 4th, lat. 38° 1′, lon. 51° 42′; 4 P. M. wind S. E., single-reefed topsails; 6 P. M. double-reefed, furled foresail, mainsail and jib, gale S. E., and rain. Oct. 5th, wind S. S. E., moderating, lat. 36° 55′, lon. 55° 28′. Oct. 6th, noon, lat. 37° 38′, lon. 57° 55′, [391 miles R.,] winds S. W., moderate; 5 P. M. increasing; 8 P. M. S. W., do.; double-reefed topsails, furled mainsail and jib; 10 P. M. gale at S. S. W., increasing, close-reefed topsails and furled foresail. Oct. 7th, gale continues; 6 A. M. S. W. by S., furled fore-topsail; 9 A. M. W. S. W.; noon, lat. 37° 54′, lon. 59° 57′, [304 miles R.,] gale continues from W., lying to under close-reefed main-topsail; 6 P. M. moderating; 7 P. M. set fore-topsail; 10 P. M. set foresail and mainsail. [This vessel was two days behind the *Wm. Engs*, on a more northern track, and at noon of 6th was 150 miles more eastward than the latter.]

Capt. CATERMOLE states that in the night of the 6th, his barometer had fallen to 28·10,* attended by a continued roar in the air; soon after, the hurricane struck the ship with tremendous force from a point E of S.; afterwards veering gradually to S. S. W., W. and W. N. W.

157. Sloop *Hellespont* encountered the hurricane lat. 40°, lon. 63° 30′, and was thrown on her beam ends. The wind veered from S. S. E. towards S. W., and the sympiesometer fell to 28·50 in., [57 miles R.]

158. Ship *Sheridan*, for Liverpool, Oct. 6th, lat. 42°, lon. 62°; P. M. wind W., 6 knots; 6 P. M. N., 5 knots, course E. by S.; 11 P. M. wind E.; midnight, tacked ship, wind increasing, [75 miles R.] Oct. 7th, double-reefed topsails; 4 A. M. fresh breezes from S. and rain; 6 A. M. out one reef; 7 A. M. wind S. S. W., continues fresh gale and high sea; noon, lat. 42° 40′, lon. 58° 30′, 116 miles R.;] P. M. blowing strong from S. W.; [probably opposite the axis of the gale about 3·30 P. M., then 140 miles distant;] 9 P. M. wind W.; midnight blowing strong from W. Oct. 8th, daylight, strong gale and heavy sea; 9 A. M.

* This barometer was left in Europe on the return voyage and could not be examined, but I infer, from the ship's position, that its index error must have been uncommonly large. Capt. C. states, however, that the effect on his sympiesometer was also very great.

wind W. N. W.; noon, moderating, lat. 44°, lon. 53° 30′; [270 miles R.;] P. M. strong breeze from W. N. W. and a high sea running; midnight, same. Next day, wind W. S. W. steady.

159. Ship *Memphis*, for New York, Oct. 4th, lat. 42° 38′, lon. 54°, ends with fresh gales from S. E. and heavy rain; in double reefs. Oct. 5th, gale S. E., strong; noon, moderate and a large sea, lat. 42° 48′, lon. 58° 58′; P. M. winds W. S. W. and W. Oct. 6th, A. M. winds W. N. W. and W., lat. 43° 20′, lon 58° 50′; P. M. winds W. and W. by N., fine weather, with a large swell from southward; 10 P. M. a shift of wind to eastward; 11 P. M. E., light airs with rain. Oct. 7th, wind E. S. E., increasing, double-reefed topsail, took in jib and mainsail; 5 A. M. gale S. E., reefed foresail, took in fore and mizen-topsail, heavy gale; 11 A. M. E.; noon, S. E., lat. 43° 16′, lon. 60°, [34 miles R.;] 1 P. M. *violent gale from S. W.*, with a tremendous sea; 4 P. M. wore ship, took in foresail and hove to; boarded heavily by the sea; 6 P. M. gale had veered to W., moderating; 9 P. M. W. N. W.; midnight, gale blowing strong from W. Oct. 8th, at daylight, out double-reefs, set whole courses and jib, wind S. W. by W., with a large sea on, lat. 42° 43′, lon. 60° 20′; P. M. winds W. N. W. and N. W., set top gt. sails.

160. Ship *Europe*,* for New York, Oct. 6th, lat. 44° 57′, lon. 56° 30′, winds S. W. to N. W. Oct. 7th, 4 A. M. wind S. E., light; 8 A. M. strong at S. S. E., took in top gt. sails; 10 A. M. gale increasing, close-reefed topsails, furled jib and mainsail, hard squalls of wind and rain; noon, gale had veered to S., lat. 44° 19′, lon. 58°, [51 miles R.,] gale increasing and at 2 P. M. had backed to S. E., took in main-topsail and foresail; [3·03 P. M. axis of gale perhaps 45 miles distant;] 4 P. M. the gale was heavy from W. S. W., split fore-topsail; 6 P. M. hard gales and tremendous squalls, with a heavy sea, lying to; midnight, gale continues, having veered to W. Oct. 8th, 4 A. M. gale W. N. W; 6 A. M. split the fore-topmast-staysail; 10 A. M. gale abating, set close-reefed fore and mizen-topsails; noon, moderating, a high swell from W. N. W., lat. 43° 35′, lon. 56° 30′; P. M. moderating; at midnight made all sail. The barometer fell very low, both previous to and during the gale.

161. St. Johns, N. F., lat. 47° 34′, lon. 52° 38′, [85 miles, R. (?)] by Mr. TEMPLEMAN, barometric observations taken at 9 A. M. and 9 P. M., the barometer 140 feet above tide. Oct. 3d, bar. 30·25, 30·28; light variable winds and cloudy; P. M. light winds S. E. to S. W. 4th, bar. 30·30, 30·23, light breeze S. S. W. overcast and gloomy; P. M. frequent showers. 5th, bar. 30·05, 29·46, fresh breeze S. S. E., overcast and gloomy; P. M. strong breeze and driving rain; [first Cuba storm;] 9 P. M. fine. 6th, bar. 29·38, 29·60, fresh breeze S. W., cloudy; fine evening. 7th, bar. 29·78, 29·40; light variable winds, overcast and gloomy; 10 A. M. wind E., rain; P. M. wind E. S. E., rain. 8th, bar. 29·38, 29·41, light variable winds, dark and gloomy; P. M. wind fresh from S. W. to W. 9th, bar. 29·48, 29·43, moderate breeze N. W. and cloudy.

The logbook of H. M. S. *Eurydice*, then in the harbor, gives the wind easterly, 5, at the beginning of the 8th; in the second watch [4h. to 8h.] a calm; 3d watch, W. S. W., 2; P. M. W. by S., 3, and W. by N., 4, 5, and 6. Oct. 9th, A. M. W. to N. W., 5; bar., at noon, 29·56. [The harbor of St. Johns, on the E. coast, is deeply sheltered, with a narrow entrance.]

162. Ship *Independence*, for New York, Oct. 5th, lat. 47° 17′; P. M. winds N. W., and W. by N., light; 8 P. M. S. W., ends S. S. W. Oct. 6th, wind strong from S. W.; 2 A. M. furled top gt. sails; 5 A. M. W. S. W., increasing; 6 A. M. close-reefed fore-topsails and courses; 8 A. M. furled fore and main-topsails and mainsail; 10 A. M gale still W. S. W.; noon, heavy gale with rain, lat. 47° 40′, lon. 42° 41′; [first Cuba gale;] 1 P. M. W. blowing heavy; 5 P. M. more moderate, set fore and mizen topsails.

Oct. 7th, at 7 A. M. wind N. W.; noon, sun obscured, lat. 48° 26′, lon. 43°; P. M. commences blowing fresh from N. W.; 4 P. M. passed steamer *Britannia* from Halifax; wind moderating, made all sail; midnight, wind E. Oct. 8th, *commences with easterly winds*; noon, calm and rainy, lat. 47° 26′, lon. 45° 37′; [280 miles R. (?)] P. M. strong gale from N. W. and W. N. W., double-reefed. Oct. 9th, strong gales from N. W. and W. N. W.; noon, lat. 45° 20′, lon. 46°.

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* Liverpool packet: second ship of this name.

163. Ship *Adirondack*, Oct. 5th, P. M. wind W. by S., light and pleasant; midnight, light winds and clear weather. Oct. 6th, 4 A. M. cloudy, took in top gt. sails; 8 A. M. thick weather with rain, wind S. W., double-reefed the topsails; 10 A. M. reefed, and set mainsail and jib; at noon heavy gales, sail reduced to close-reefed main-topsail, spanker, and main spencer; no observation; P. M. heavy gale from S. W. and thick weather; at 4 P. M. set reefed foresail. [This was the prelusive gale, which in this region was stronger than the succeeding one.]

Oct. 7th, at 1 A. M. wind W. N. W.; 3 A. M. set close-reefed fore and mizen-topsails; 5 A. M. set double-reefed mainsail and jib; 11 A. M. turned close-reefs out of fore and main-topsail, and first reef out of mainsail, lat. obs. 46° 56′, lon. 41° 08′; P. M. wind N. W. by N., under double-reefed topsails and courses; from 2 to 4 P. M. turned out reefs; 7 P. M. set top gt. sails. [End of first Cuba gale.] All night, calm and light airs, with thick, dark and rainy weather. Oct. 8th, 2 A. M. wind at S. E.; 4 A. M. E.; 6 A. M. N. E., and E.; set main top gt. sail; 8 A. M. baffling and squally, wind hauling to southward with rain; double-reefed the courses and spanker and stowed the jib; noon, cloudy, no observation; [about 415 miles R. of axis line;] P. M. wind N. W. by W., fresh gales and cloudy weather; 3 P. M. out reefs; from 3 to 7 P. M. wind went round to S. and E.; 8 P. M. W. N. W.; through the night dark and squally. Oct. 9th, wind W., fresh gales and squally; at 4 P. M. heavy squalls, close-reefed the topsails; 8 P. M. set the main-topsail; through the night clear and cold, with a heavy sea. Oct. 10th, lat. 46° 18′, lon. 47° 44′.

164. Ship *Prince Albert*, for New York, Oct. 4th, A. M. strong breeze N. E. to N., 10 knots; squally and large head sea, pitching heavily and carrying all sail. *Passed large quantities of gulf weed;* noon, lat. 46° 32′, lon. (chr.) 38° 30′; *bar.* 30·24, [its adjustment correct,] air 57°, water 66°; P. M. wind N. moderate, clear and pleasant; 9 P. M. N. N. W. Oct. 5th, wind N., 6 knots; 5 A. M. N. N. W.; 10 A. M. N. N. E., moderate and pleasant; noon, light airs N. N. E., lat. 45° 40′, lon. 41° 36′; 2 P. M. S., 2 knots; 4 P. M. S. S. W., 3 knots; 6 P. M. S. W., 8 knots; 9 P. M. S. W. by S., still increasing; ends strong and squally, double-reefed fore and mizen-topsails. Oct. 6th, begins S. S. W., 9 knots; 2 A. M. S. W., strong, squally, and a large sea; 4 A. M. double-reefed main-topsail and reefed mainsail; at 7 P. M. furled jib and mizen-topsail; noon, strong winds, large sea, and constant rain, lat. 45°, lon. 45° 41′; P. M. wind W. S. W., moderating and constant rain; set single-reefed topsails, jib and top gt. sails; 6 P. M. wind W., latter part fresh breezes and cloudy.

Oct. 7th, A. M. fresh breeze and cloudy, *with large swell from S. W.*; after 4 A. M. out all reefs; [end of first Cuba gale;] noon, W., lat. obs. 45° 30′, lon. 46° 50′; 1 P. M. E., light; at 4, S. S. E., light; at 6 W. by S.; 7 P. M. fresh; in light sails; ends with strong wind, constant rain, and thick fog. Oct. 8th, [325 miles R. from supposed axis line,] wind W., strong, small rain and thick fog; 3 A. M. heavy squalls; in two reefs; 5 A. M. W. by N.; 7 A. M. out one reef and set main top gt. sail; 8 P. M. W. N. W.; 10 A. M. took in top gt. sail; noon, strong winds and heavy sea, ship laboring hard; lat. obs. 45° 6′, lon. chr. 49°; P. M. W. N. W., weather unchanged; 5 P. M. W. by N.; 8 P. M. out all reefs; latter part brisk breeze and clear pleasant weather. Oct. 9th, brisk wind from W. and large westerly swell, ship laboring heavy; 9 A. M. exchanged signals with English ship *Wallace*, steering S. under close-reefed topsails, reefed courses and jib furled; at 11 increasing wind, squally, in top gt. sails; noon, lat. 44° 21′, on the Banks; P. M. fresh wind from W., clear and pleasant, and heavy swell from W. N. W.; latter part light and pleasant.

[The *Prince Albert* is one of the many New York packet ships that are found in the foregoing recitals. Capt. SEBOR's logbook is always kept in civil time; as is the case with some others, also, of these fine vessels. It is hoped that the practice will become universal.]

Further trace of the first storm and also of the progress of the right limb of the second or great gale, is afforded by the log of the R. M. steamer *Britannia*, in her voyage from Halifax for Liverpool, which, on account of the importance of pursuing the

inquiry in the higher latitudes and towards Europe, is here subjoined.

165. R. M. steamer *Britannia*, Oct. 3d, 1844, at 12h. 15m. received the mails at Halifax and proceeded to sea; wind S. S. E., increasing; midnight, strong breeze and cloudy.

Oct. 4th, wind S. S. E., strong breeze and cloudy; 9 A. M. strong breeze and weather fine; noon, same, lat. 44° 54′, lon. 59° 10′. Distance run, 196 miles. 1 P. M. strong breeze and clear weather; 3 P. M. wind S. E., increasing; cloudy; 8 P. M. fresh gale and squally, sea getting up; midnight, strong gales and squally with rain.

Oct. 5th, begins strong gales from S. S. E. and heavy squalls with a high sea; 4 A. M. the same; 8 A. M. gale increasing, ship laboring and shipping much water over all, reefed the fore and aft-sails; 10 A. M. hard gale and heavy sea, with thick hazy weather. [First Cuba gale.] Noon, wind and weather the same; lat. 45° 58′, lon. 55° 30′. Distance 168 miles. P. M. strong gales from S. S. W., and squally weather with a heavy beam sea and constant rain; 4 P. M. more moderate, set the topsail and shook out reefs; 6 P. M. wind increasing again, in first reef of topsail; 10.30 P. M. out reefs and set foresail; more moderate, and clear. [Remission, and approaching westerly change of the first Cuba gale.]

Oct. 6th, wind S. W. moderate, and clear weather, with a heavy beam sea; 7 A. M. wind W. S. W., set topmast and lower studding-sails; 8 A. M. light breeze and fine clear weather *with a heavy beam sea;* noon, lat. 46° 44′, lon. 51° 3′. Distance 198 miles. Cape Race, N. F., bearing W. ¼ S. 78 miles; P. M. moderate breeze from W. S. W. and clear weather; 4 P. M. increasing breeze and hazy weather; 8 P. M. blowing strong breeze; midnight, wind W., more moderate. [Rear side of first gale not strongly developed, as a surface wind.]

Oct. 7th, moderate and hazy, wind W., inclining to N. W.; 2 A. M. wind W. N. W.; 8 A. M. wind N. N. W.; 9 A. M. breeze increasing, cloudy; 10 A. M. wind N.; noon, fresh breeze and cloudy, lat. 48° 5′, lon. 45° 41′. Distance 233 miles. [330 miles R. of supposed axis line.] P. M. moderate breeze and cloudy weather, *with a heavy N. E. swell;* 2 P. M. wind N. N. W.; 5 P. M. passed packet ship *Independence*, standing S. W.; 7 A. M. light variable winds and rain; in all fore and aft-sails; midnight, light breeze and dark rainy weather. [This N. E. swell shows the strength of the gale to have been on the *left* of the axis, in a higher latitude.]

Oct. 8th, light breeze from E., *dark and rainy with a heavy N. E. swell;* [second Cuba storm;] 4 A. M. same; 7 A. M. increasing breeze from E. by S., down top gt. yard and mast and fore-yard; 11, set the fore and aft-sails; noon, moderate and cloudy; lat. 48° 43′, lon. 40° 28′. Distance 213 miles. [350 miles R. of supposed axis line.] 1 P. M. wind E. by S., cloudy, with a *heavy N. E. swell;* 8 P. M. light wind and clear; ends the same. [The easterly winds of second storm had taken effect but moderately this day.]

Oct. 9th, light winds from S. S. E. with a *heavy N. E. swell;* 8 A. M. light airs from S. W.; noon, light winds and cloudy; lat. 49° 14′, lon. 35° 6′. Distance 212 miles. [448 miles R. of supposed axis line.] P. M. light breeze from S. W. and clear weather, with a *heavy N. E. swell;* 6 P. M. wind S. S. E.; 8 P. M. light wind and rain; 9 P. M. wind S. W.; 10 P. M. wind shifted to N. W.; ends moderate and clear. [Easterly part of gale lightly felt, and westerly part but just commenced.]

Oct. 10th, moderate breeze from N. W. and clear; 6 A. M. increasing breeze and cloudy, with *a very heavy cross swell;* noon, lat. 49° 46′, lon. 29°. Distance 237 miles. P. M. fresh breeze from N. W. and fine clear weather; 8 P. M. wind dying away; midnight, light breeze and dark cloudy weather. [Apparent end of the observations on the second Cuba gale; unless viewed as a remission, with a renewal on the 11th.]

Oct. 11th, light winds from S. W. and cloudy, with heavy showers of rain; 4 A. M. increasing breeze and a heavy sea; 7, in first reef of fore-topsail; 8, strong gales and cloudy, close-reefed fore-topsail, and furled fore and aft-sails; noon, strong gales and a heavy cross sea; lat. 50° 26′, lon. 22° 50′. Distance 240 miles. P. M. strong gales and dark weather with frequent showers of rain and a cross sea, sent down top gt. mast; 5, set reefed foresail; 8 P. M. more moderate, with heavy rain; 10 P. M. wind hauling forward, in foresail, dark and threatening weather. [A third storm approaching, probably from the lower latitudes of the Atlantic.]

Oct. 12th, begins moderate breeze from S. by W., and dark cloudy weather; 8 A. M. the same; noon, light breeze and cloudy; lat. 50° 46′, lon. 17° 20′. Distance 225 miles. At 1 P. M. a heavy squall from N. W. which ended in a strong gale; 2 P. M. set close-reefed fore-topsail; 4 P. M. strong gales and squally; 6 P. M. in second reef of foresail; 8 P. M. dark weather, heavy sea running; midnight, same, with a very heavy sea.

Oct. 13th, strong gales from W. N. W. and squally, with a high sea; 3 A. M. wind W.; 8 A. M. wind W. N. W., more moderate; 9 A. M. strong breeze and cloudy; noon, the same; lat. 51° 6′, lon. 11° 5′. Distance 260 miles. Cape Clear bearing E. by N. 63 miles. P. M. wind W., squally, with rain and a high sea; 6 P. M. wind S. W. [*End of Log.*]

We may notice in the log of the *Britannia*, that the length of the observed intervals between the several storm-winds, as well as the duration of these winds, was greatly prolonged by the rapid progress of the vessel in a northeasterly direction. Thus, the change of the first gale to the western board was not observed till past noon of Oct. 5th; although it took place at Halifax previous to 4 A. M. The westerly winds of this gale did not cease with the steamer till P. M. of the 7th; while they had ended at Halifax in the evening of the 6th. The easterly winds of the second gale set in, near Cape Canso, early on the 7th, but did not *overtake* the steamer till near 24 hours later and were but lightly exhibited; while the heavy swell from N. E. seems connected with the more active portion of the gale, which was in a more northerly and advanced position. The *westerly* winds of the second storm, which took effect off Halifax in the afternoon of the 7th, appear not to have reached the steamer till late on the 9th, in lon. 32° W. and then with greatly diminished force. The steamer kept company, for a long time, with the "beam sea" from S. S. E., of the first gale; and, subsequently, with the "N. E. swell" from the active and more advanced portion of the second storm:—showing the progression of these great disturbances to have been in different directions from that of the waves themselves.

It is much to be regretted that no entries of the state of the barometer are found in the Britannia's log, although a column had been provided for this purpose in the logbook.

The northwesterly wind of the second Cuba gale seems finally to have left the Britannia on the 10th or 11th of October. What had then become of this storm and its predecessor does not clearly appear; but it is probable that they were continued, in some unknown condition, in the region lying between Iceland and the European continent.

We may notice that the first of these Cuba storms, which from Florida to New York could scarcely be traced, except barometrically, has appeared the most active of the two after it passed beyond Newfoundland. These latter observations, however, appear to have been made in positions which were much exterior to the most active portions of the two gales; which could not have coincided with each other in their axis-routes, through any known portion of their progression.

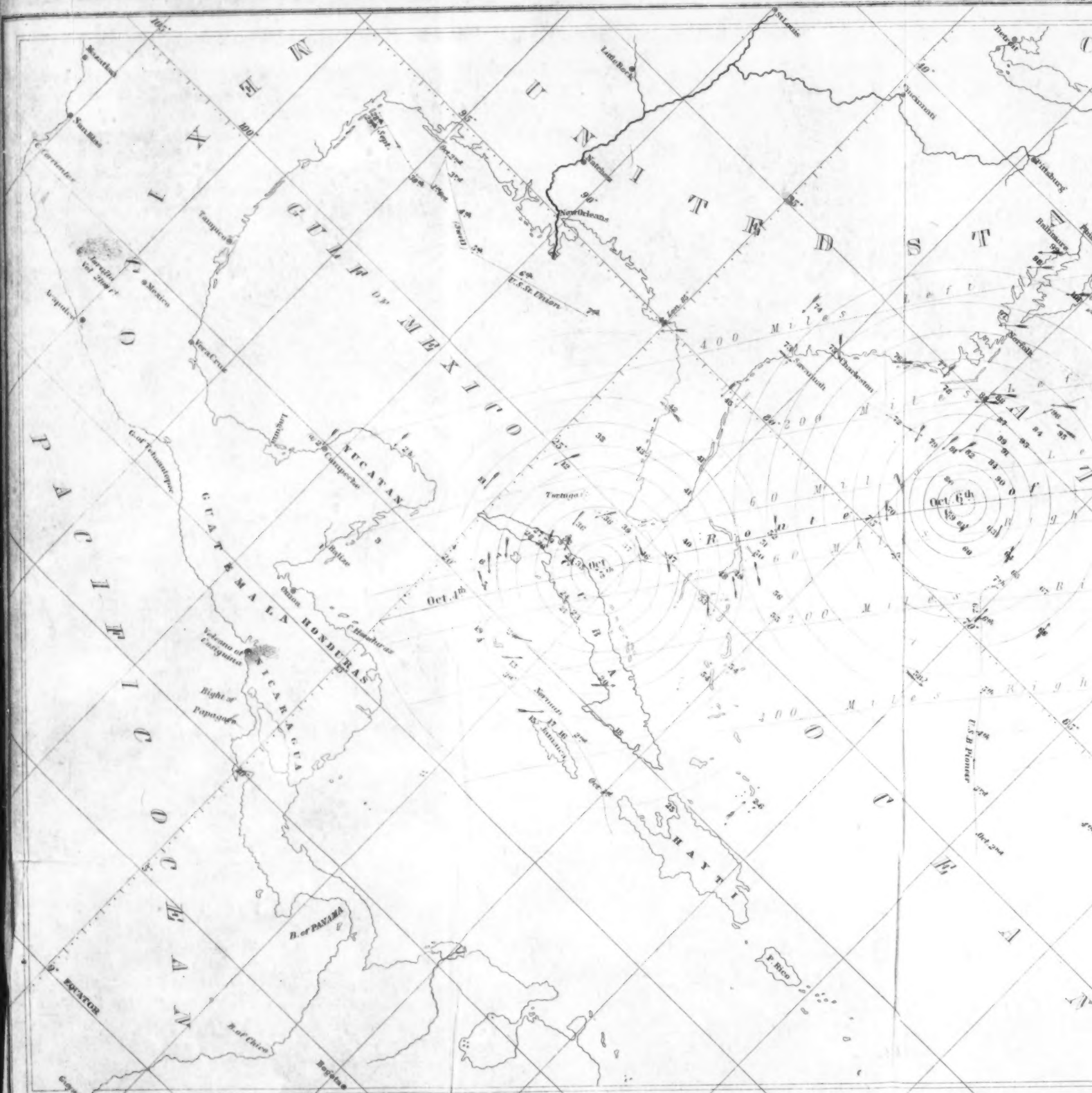
On the 11th or 12th of October the steamer took another storm, which we do not recognize as of American origin; which, at 1 P. M. on the 12th, changed to N. W. and blew a strong gale, and accompanied the steamer on the 13th, to the coast of Ireland.

Gales of the European Seas at this period.

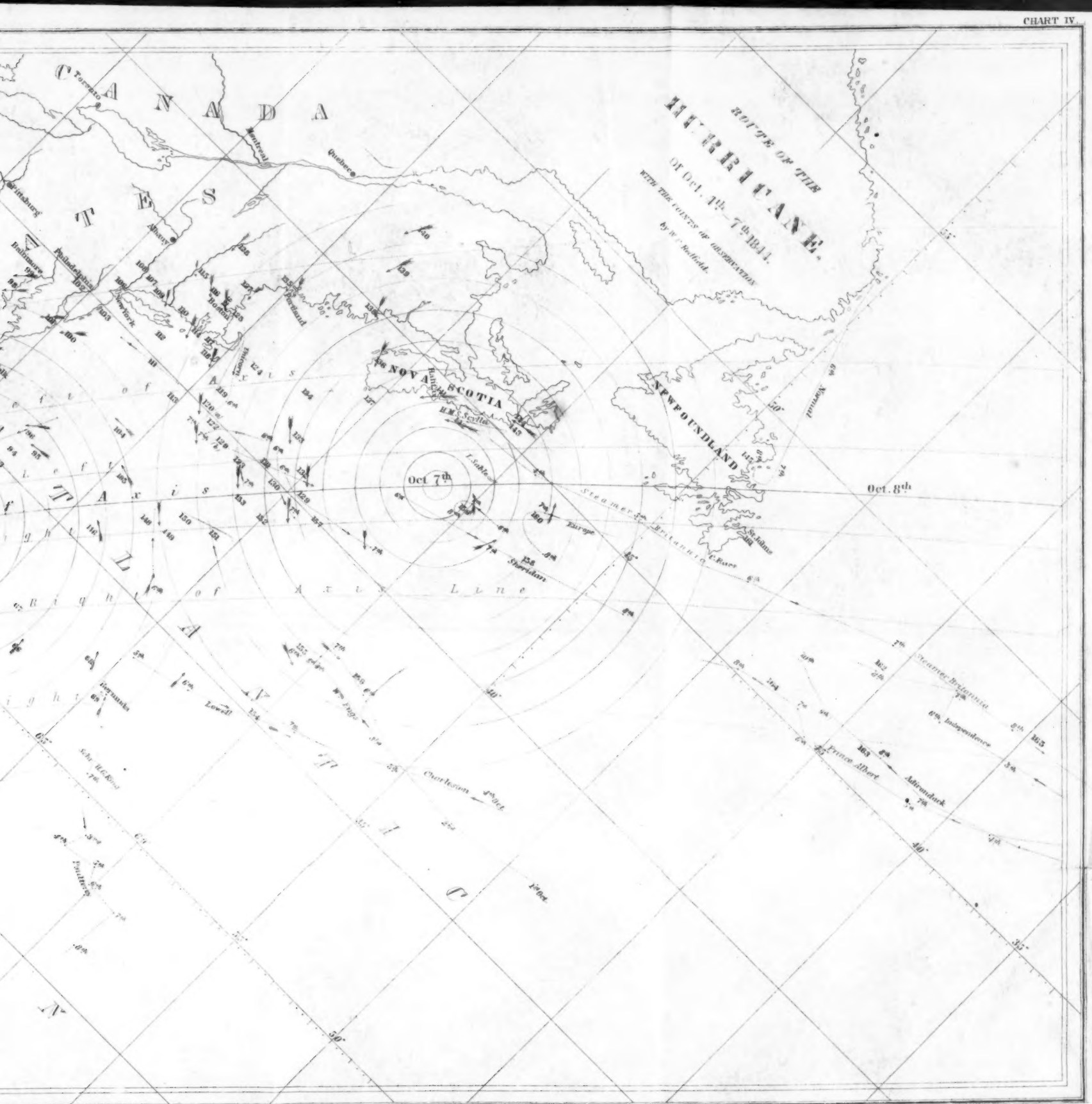
So far as relates to the more immediate objects of this inquiry, the foregoing recitals may suffice. But the relations of the American storms to those of the European seas and coasts are of much importance in meteorology; and we may take, therefore, a hasty glance at the phenomena exhibited by the storms of this period, on the eastern borders of the North Atlantic; as consecutive with the foregoing recitals.

At Lerwick, Shetland, near lat. 60° N., lon. 1° 30′ W., "a heavy gale of wind commenced at South at 5 A. M. Oct. 8th, and veered on the morning of the 11th to E. S. E." "At 7 A. M. of the 10th, during a heavy gale from E. S. E., the *Jesmond*, from Archangel for Hull, drove ashore near Lerwick."—*Shipping Reports*. May not this storm have been identical with one, if not both of the Cuba gales? For we have seen that both these gales were comprised in one extensive barometric depression. For my own part, I am somewhat inclined to this opinion; which may be verified, perhaps, by observations from Iceland or the Ferro Islands, and by logbooks of ships then in the northern portions of the Atlantic. "The *Jane Pope*, from Dundee for Riga, on the 10th October, in lat. 57° 50′ N., lon. 1° 30′ E., experienced a tremendous gale from S. by E., and shipped a heavy sea, which swept five of the crew off the decks." This was doubtless the same gale that visited Shetland.

Oporto, [lat. 41° 11′, lon. 8° 38′ W.] Oct. 14th. "It blew very fresh here on the 9th. The *Ostsee*, from Lisbon, was driven



Engd by J.M. Atwood N.Y. The three sets of circles serve to represent the successive positions of the storm, at or near noon on the 5th 6th and 7th days of Oct. respectively. The wind arrows show the direct



ow the direction of the wind at these periods, at various points, as derived directly or approximately from the printed observations.

Curves
Places

on shore six miles southward of the bar." Two other vessels were also wrecked at Oporto. At the Scilly Islands, entrance of the English channel, "it blew a terrific hurricane" on the 9th. Foway, (Cornwall,) Oct. 12th: The *Julia*, from Venice for London, experienced a dreadful gale on the 9th inst. at W. N. W.—This storm was generally heavy on the coasts of England and Ireland, and had increased to a hurricane from southeast, at Dublin, on the afternoon and night of the 9th. Several vessels were driven on shore by the gale, at the same period, on the east coast of England. At Elsineur, entrance of the Baltic, (lat 56° 2′, lon. 12° 37′ E.) on the 10th and 11th October, a strong gale from S. E.: the wind had been S. E. on the 9th. This was probably the same as the above gale of the 9th. On the coast of Cornwall it was also blowing a gale from S. S. W. on the 12th and 13th; apparently, another storm.

In the interior portions of England, the storms of this period do not appear to have attracted notice. The register of Mr. Rogerson, of the Royal Observatory at Greenwich, shows that the barometer attained a maximum of 30·37 Sept. 30th; and, after strong S. W. winds a second maximum of 30·01 on the morning of Oct. 4th, which last could hardly have coincided with the advancing front of the great American wave, the summit of which was then not greatly advanced from Newfoundland.* On the 5th, 6th, and 7th, the winds were S. W. and thence to N. W.; on the 8th, S. E. and S. W., and on the 9th *the barometer had fallen to* 29·23 *at* 9 A. M., and 29·17 *at* 3 P. M., with the winds strong at S.; and the bar. was but little higher on the 10th, with the wind at S. and S. W. Perhaps this depression may have been identical with the first Cuba gale, as it doubtless was with that of Shetland.

Col. Reid has favored me with a valuable account of the gale of Oct. 9th and following days, as found in the log of H. M. S. *Windsor*, bound outward from the English channel; of which the subjoined is an abstract.

Oct. 7th, A. M. wind N. N. W. moderate; noon, lat. 49° 47′, lon. 4° 23′ W. *bar.* 30 in.; P. M. wind S. S. W., increasing. Oct. 8th, noon, lat. 49° 20′, lon. 7°, *bar.* 29·50; the whole 24 hours very unsettled weather and barometer falling; wind S. W., unsteady, and increasing. Oct. 9th, wind had veered to N. N. W., coming in hard gusts with sudden intermissions *and barometer had fallen to* 28·60; sent down small spars, double-reefed, &c.; at 8 A. M. *bar.* 28·50, and weather clearing up to the eastward; thought of making sail not-

* See bar. obs. at St. Johns, and on board the *Prince Albert*, lon. 38° 30′.

withstanding the low state of the barometer. Saw a schooner close to us with a good spread of canvass. But the wind suddenly flew out from N. E. and back to E. S. E., then E., and we observed the water blown up like clouds of dust and the sea in frightful commotion. This took place at 1·30 P. M.; the *barometer* having been 28·44 at noon, 28·35 at 0·30 P. M., and lowest at 1 P. M. 28·12. It was now (1·30 P. M.) at 28·14, and before the canvass could be got in, the hurricane had struck the ship from the northward with extreme violence, driving her *forecastle under;* at 2 P. M. *bar.* 28·40; at 3 P. M. with great difficulty brought the ship to, on starboard tack; 3 P. M. *bar.* 28·60; at 5 P. M. hurricane less violent, and settled into a heavy gale, veering to N. W. and W. N. W.; at 8 P. M. severe gale, with sleet, hail, rain and vivid lightning; at midnight, *bar.* 28·99; gale blowing with unabated violence.—The schooner which was close to us disappeared suddenly, and there is little doubt that she foundered. Oct. 10th, heavy gale from N. N. W. with a high sea; noon, lat. 48° 51′, lon. 8° 4′ W., *bar.* 29·40; midnight, no alteration.

The steamer *Britannia*, at noon of the 10th, was 927 English miles W. by N. of the *Windsor*, and was then running in the N. W. wind or rearward portion of the *second* Cuba storm. This is not incompatible with the idea that these storms may all have pertained to the general area of a great barometrical depression, though divisible, at the earth's surface, into two or three stormy vortices, which may have continued more or less distinct from each other, in successive localities.

It appears, also, that the *Severn* for Liverpool, Oct. 13th, in lat. 48° 49′, lon. 16° 4′ W., encountered "a perfect hurricane," with a tremendous sea. Likewise, the barque *Providence*, Oct. 13th, lat. 49°, lon. 13°, had a severe gale, lost spars, &c. This was the gale which the *Britannia* experienced, less severely, near the coast of Ireland.

From the courses which we have seen pursued by the two associated storms in the Western Atlantic, I have supposed their further progress to have been on lines somewhat curvilinear, towards Iceland or that part of the Atlantic which lies between Iceland and the British islands. Their direct identity or immediate connexion with the European storms already noticed, may be considered as doubtful. If we suppose the Cuba storms to have acquired, gradually, a southeastern progression in higher latitudes, before reaching the British islands, the difficulties of allowing a partial identity might be lessened; and, possibly, the wave-like propagation of the barometric oscillations, from different parts of the line of progress, may have induced some of the complications of the barometric waves which serve to embarrass the inquiry:—complications which are not uncommon in northern Europe. Such southeastern progression might serve to explain the veering of the wind *from the southern or southwestern quarter to the northeastern*, which appears in some of the above European reports.

and was also found in the *extremely* violent hurricane of Dec. 12th, 1844, in the Eastern Atlantic, in which two of the New York packet ships were lost by foundering; a fact unexampled in the history of our navigation. But such southeastern course in a great storm of the northern hemisphere, so far as I know, has not yet been established.

It has been shown by MILNE and others that several of the British storms have pursued a northeasterly course, in their progress from lower latitudes, and that their rotative action was from right to left, ↻, as in the North American gales. In order to obtain a more definite and correct estimate of the progression and extended relations of the European storms above noticed, it would be proper to examine observations made at Madeira and the Azores, in connexion with such other geographical data as might be obtained by patient inquiry.*

We next proceed to a review of the phenomena of the Cuba hurricane and its prelusive storm, while in progress from the shores of Central America to the Gulf of St. Lawrence and Newfoundland.

ART. III.—*Description of a new Fossil Fish, from the Palæozoic Rocks of Indiana;* by J. G. NORWOOD, M. D., and D. D. OWEN, M. D.

WITHIN a few months a very interesting discovery of a fossil fish has been made fifteen miles N. W. of Madison, Jefferson county, Indiana, in the rock forming the bed of Lewis's creek, a branch of the Muskatatac river.

Unfortunately, before the specimen came under our inspection, it had suffered greatly from thoughtless mutilation, while in the hands of the quarryman, which renders it difficult to give a satisfactory description of this remarkable fossil.

* T. C. HUNT, Esq., the British Consul at the Azores, has been indefatigable in his endeavors to secure good observations at these islands and Madeira; where the meteorological phenomena may sometimes have important relations to those of the coasts of western Europe, or other parts of the Atlantic basin. I am indebted to Col. REID and to Consul General HUNT for valuable records and communications on the meteorology of those islands, of an earlier date than the storms now under consideration.

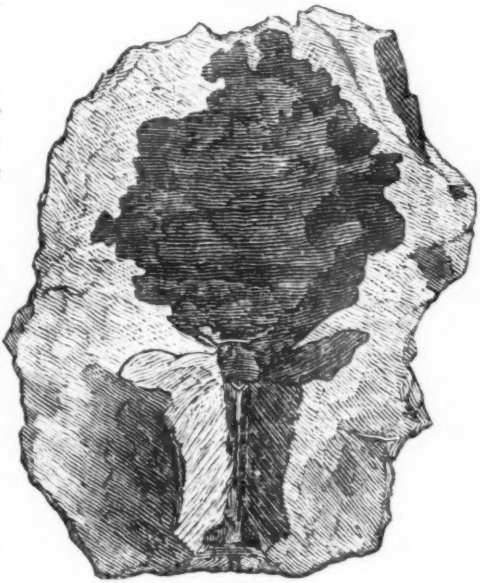
The accompanying figure, (No. 1,) gives a view of the upper surface of the fossil in its present condition. No. 2 represents the under surface, but the figure is not as perfect as the one of the upper surface.

In length it measures ten inches; in width, following its greatest convexity, nine and one fourth inches; its average thickness is about one and one fourth inches. It is evident that the fossil is a ganoid fish, analogous to those described from the Devonian System of Europe. The head and anterior part of the body are covered with large angular osseous plates or scutcheons; they differ, however, in number, form and position, from those of any of the European fossil fishes we have seen figured.

Eight plates only are visible. Their

Fig. 1.

Fig. 2.



outline and relative position are distinctly shown in figure 1; so, also, are the radiating lines of ossification. They present no appearance of tuberculation, unless the slight elevations which form the centres from which these radiations proceed, can be so considered.

The anterior plate is oval-lanceolate, and was evidently prolonged into a snout, not unlike that of some species of Chondropterygii.

From the central lateral scutcheon plates project two marked prominences, which seem to have been the articulating surfaces of two spinous lateral appendages, perhaps somewhat similar to those of the *Pterichthys cornutus*, described by Hugh Miller.* What renders this supposition still more probable, is, the quarryman affirms, that before it was mutilated, it had "two great horns" projecting from that part of its head.

The scutcheons were evidently covered with angular, irregularly rhomboidal, and highly enamelled, but minute scales, for many of them are well preserved, especially on the left posterior scutcheon. With a magnifying glass the enamel of some of them appears to be even translucent.

No eyes are distinguishable on the part from which the drawing was taken; but, on the mould from which the specimen was removed, and which we fortunately discovered during a recent visit to the locality, a smooth, convex surface can be seen on both sides, anterior to the position of the spinous appendages, which may, possibly, be remains of eyes; but the structure is not sufficiently distinct to enable one to form a decided opinion.

The end view of the posterior portion of the fossil exhibits in the median line, three tenths of an inch beneath the upper convex surface of the body, a beautifully distinct condyloid articulating surface, composed of two ovoid, smooth prominences, separated by a slight groove; where, probably, was attached either the posterior portion of the body or the tail.

The under surface is irregularly concave, presenting a polished aspect towards the anterior and central part where the fossil is uninjured, and is partially incrusted with a thin, dark, smooth, glossy, lamellar substance, but without any radiations or sutures indicative of plates.

The lateral posterior parts are rough and irregular, presenting merely the fracture of the rock. But, situated between these

* "New Walks in an Old Field."

rough, irregular surfaces, in the median line, and occupying the posterior portion of the fossil, are two smooth, divergent planes, slightly convex anteriorly, and turning forwards and outwards, forming, together, an arch two and a half inches long, one and nine tenths of an inch wide at their outer and most divergent edges, and seven tenths of an inch deep. These surfaces do not meet precisely at the top of the arch, but are separated by a small and slightly elevated angular groove, divergent anteriorly and posteriorly, in which latter direction it seems to terminate in two slightly convex articulating surfaces, sloping off, posteriorly, into a smooth concave depression, forming the segment of an arch, which is separated by a bow-shaped and rather sharp ridge from the before mentioned ovoid condyloid surfaces.

This arch formed, perhaps, the pharyngeal walls, while the angular groove in its vertex, which was a closed canal before the fracture of the fossil, served for the lodgment of medullary matter.

Geological position.—With a view to ascertain the exact stratigraphical place of this specimen, we visited the quarry a few weeks since, and were fortunate enough to discover the rock containing the mould of the fossil in question, so that its exact geological position has been most satisfactorily ascertained. This interesting relic was split out of a subcrystalline layer of light grey limestone, containing numerous *Atrypa prisca* and *Spirifer euruteines* (perhaps a small variety of *Delthyris congesta*); associated with *Strophomena euglypha*, *Pterinea cardiiformis*, *Favosites spongites*, *Pileopsis tubifer? Calymene bufo*, *Tentaculites scalaris*, *Cardium alæformis*, *Calymene crassimarginata*, *Astrea flexuosa?* and other fossils characteristic of the shell beds which form part of the chain of rocks in the bed of the Ohio river at the falls, immediately under the water limestone found in digging the Louisville canal. On Lewis's creek, however, the water lime is absent, or represented only by a thin layer of chert, and the black slate is found in the bank of the creek, not four feet above the layer containing our fossil fish. This black slate is most likely the equivalent of the Genesee slate, and not of the Marcellus shale of the New York survey, since the underlying layers, though they contain several Onondaga and corniferous fossils, yield, also, many organic remains of the Hamilton group.

If this fossil fish should prove to be a new genus, as would seem to be indicated, not only by the great size of the scutcheon

plates, but also from their peculiar form, together with the posterior position of the arch-like structure on the inferior surface, we propose for it the name *Macropetalicthys rapheidolabis*, in allusion to the great size of the scutcheon plates, and the pincer-like form produced by the union of their sutures.

This is so far as we know, not only the first instance of finding scutcheoned fishes in this country, but, also, the lowest position in which remains of Vertebrata have been found, if we except defensive fin bones, which occur in New York nearly in the same geological position, viz. in the corniferous group, and the scales of fishes which the Professors Rogers traced throughout the Clinton group of Pennsylvania and Virginia.

Madison, Ia., Feb. 16, 1846.

Note by D. D. Owen.—Some of the members of the Academy of Sciences in Cincinnati, supposing it to be a *Pterichthys*, suggested the name *P. Norwoodensis* out of compliment to Dr. Norwood, who secured the specimen and first called the attention of men of science in the West to it. Dr. N. as well as myself, objects to this principle of nomenclature superseding the descriptive one; it is for this reason alone that I have consented to this decision.

ART. IV.—*Coal Field of Tuscaloosa, Alabama*,—being an extract of a letter to Prof. SILLIMAN, from CHARLES LYELL, Esq., dated Mobile, Alabama, Feb. 19th, 1846.

SINCE I wrote to you last, I have been engaged in the study of the carboniferous rocks and coal of Alabama, respecting the existence and extent of which, I was unable to obtain any accurate information, when I compiled the small geological map of the United States that accompanied my Travels. Mr. Conrad had mentioned to me the existence of a bed of coal, the geological age of which he had not ascertained, above Tuscaloosa, and I learnt from several persons on my way south, as I passed through Georgia, that the city of Mobile was supplied with bituminous coal, for fuel and gas, brought down the Tombecbee River, by a navigation of more than 350 miles. When I heard that it was procured not far from the northern outcrop of the newer formations, whether cretaceous or tertiary, that it occurred very near

the falls of the Warrior River, the principal tributary of the Tombecbee, and that it was used for the manufacture of gas at Mobile, I suspected that it might be related to the Richmond coal, which is bituminous, situated near the falls of the James River, and placed nearer the Atlantic than the coal of the Alleghany range, than which it has also been shown to be newer in date, by Prof. W. B. Rogers.

In order to determine, if possible, its chronological relations, and obtain information respecting its extent, I ascended the Tombecbee, from Mobile to Tuscaloosa, where, at the University, I found Prof. Brumby, who had examined with considerable care the geographical boundaries of the productive coal measures, and the structure of the region. With him, I made an excursion to some of the pits, or rather open quarries of coal, where the edges of the beds of several seams have been dug into by different individuals, entirely ignorant of mining operations, but with no small success, the quality being good at the points of natural outcrop. I found the coal seams every where covered with beds of ordinary black carbonaceous shale, full of impressions of more than one species of Calamite, with ferns of the genera Pecopteris and Neuropteris, and impressions of Sigillaria and Lepidodendron. In some of the beds, Stigmaria has also been met with not unfrequently. I recognize a specific identity between several of the most common of these coal plants and those of Europe, Ohio, and Pennsylvania, and I observe that they are completely different from the vegetable remains that are most abundant and characteristic in the newer or Virginian coal field, near Richmond, which I had lately an opportunity of examining on my way South. The strike also of the coal beds of Alabama, on the Warrior River, where I saw them, and those of a coal field immediately to the east, examined by Prof. Brumby, is northeast and southwest, agreeing with the general direction of the Alleghany Mountains, of which, geologically speaking, they are evidently a southern prolongation. They are in fact portions of the great Apalachian coal field, exhibiting all the same mineral and palæontological characters, the beds having been bent into anticlinal and synclinal ridges, similar to those of the Alleghenies, with corresponding dips to northwest and southeast.

Alabama is the first state, as we proceed from the northeast, where we can pass from the Atlantic plain, occupied by tertiary

and cretaceous strata, to the older rocks of the Apalachian region, without first crossing an intervening zone of the hypogene or granitic rocks. In the eastern part of the State, the crystalline formations still appear, as at Wetumpka, where, as I learn from Prof. Brumby, the lower cretaceous rocks rest upon mica schist. But on going westward to the Cahawba River, and still farther west to the Warrior, at Tuscaloosa, we find the carboniferous strata concealing the granitic rocks, or coming into direct contact with the cretaceous. At the falls of the Warrior, at Tuscaloosa, beds of gravel containing well rounded pebbles of quartz, are seen to rest unconformably on the gray micaceous sandstone of the coal, which is full of Calamites and impressions of Lepidodendron and Sigillaria. I should have felt very doubtful respecting the true age of the overlying unconsolidated gravel and sand, in which no organic remains have yet been discovered, in that neighborhood, if I had not carefully examined the position of similar beds of loose gravel 30 feet thick, at Montgomery, 100 miles southeast, on the Alabama River, as also at spots between Montgomery and Wetumpka. In nodules of an impure limestone, in a loam overlying that gravel, and almost in contact, I found casts of Inoceramus, Rostellaria arenarum, and other common chalk fossils. They are well seen at the bluff, in the suburbs of Montgomery, and there are beds of gravel, and various colored sands and clays below them; the general dip of the cretaceous strata being to the south, which brings up the edges of certain calcareous marls, newer than the gravel, but of the same epoch, producing prairie soils, often destitute of natural wood, which run for a great distance east and west, or in the line of their strike, crossing the Alabama several miles south of Montgomery, and being again seen in their western prolongation on the Tombecbee, at Arcola and other places. It is due to Mr. Conrad, to state that in an outline map which he presented to me in 1842, with permission to publish any part of it in my general map, he had traced out the course of the lower cretaceous beds, especially their northern boundary in Alabama, with great approach to accuracy, from observations made by him, and information obtained during his tour in 1833.

The members of the carboniferous series, which I examined in an excursion with Prof. Brumby, within a distance of between

30 to 40 miles northeast of Tuscaloosa, may be said to consist of three subdivisions: 1st, the productive coal measures; 2d, quartzose grit, used for millstones, with schistose sandstones and slates; 3d, limestone and chert. The first of these, or the productive coal measures, consist of the usual white sandstones and grits, so common in all coal fields, with greenish and gray micaceous sandstones, and some ripple-marked slabs of yellow sandstone, with Calamites. Associated with these, are shales and clays, with seams of coal, the thickest of those which I saw being about four feet, but a ten foot seam has been discovered sixty miles farther to the north. I saw a thickness of many hundred feet of this formation, but have no data for estimating its entire vertical extent. To the above succeeds, in the descending order, a great deposit of quartzose grit, used for millstones, which resembles in position and mineral character, the millstone grit of the north of England, and perhaps occupies the place of the fundamental conglomerate of the great Apalachian coal field. It passes downward into thinly laminated sandstones, and dark slates of small thickness. Under this group lies a formation of limestone, usually blue, with white veins of carbonate of lime, and with much chert and hornstone intermixed. In the pure limestone, which is fetid, when broken, no fossils have been found, but in some of the associated siliceous beds, Prof. Brumby has obtained Encrinites, Producta, Orthis, and one or two corals, which have not yet been determined, but the genera which I saw, are such as might belong to the carboniferous limestone. In some of the inferior beds of limestone, there is a great mixture of iron, and throughout the range of this formation, there has been traced an enormous mass of brown hematite, which seemed to me to constitute, where I examined it at Murphy's, 30 miles from Tuscaloosa, a regular bed, rather than a vein. From the abundance, accessibility and richness of this ore, its proximity to the coal field and to the navigation of the Tombecbee River, I can hardly doubt that, like the coal itself, it is destined, at no distant day, to be a source of great mineral wealth to Alabama. I may also mention that large specimens of pure galena, obtained from this limestone formation, have been shown me by Prof. Brumby, who found them in the counties of Tuscaloosa, Bibb, Shelby, Jefferson, and Blount, as also in the Tennessee valley, in Alabama;

but no search has yet been made by miners to ascertain whether the lead could be worked to advantage.

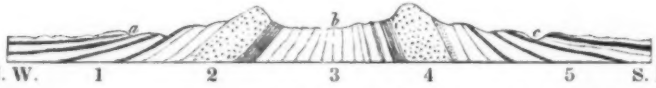
It would have been impossible for me, during my short visit to this region, to form more than a conjectural opinion respecting its structure, still less could I have determined the geographical area of the Alabama coal fields, had not these subjects been previously studied, with great care and scientific ability, by Prof. Brumby. Of the extent of the coal, he published a brief account in Barnard's Almanac for 1838, and communicated the same to Dr. Silliman. It appears that south of the waters flowing to the Tennessee, there are two parallel coal fields—those of the Warrior and Cahawba rivers. The western of the two, that of the Warrior, has a length of more than 90 miles from northeast to southwest, and a breadth of from 10 to 30 miles. It extends through the counties of Tuscaloosa, Walker, Jefferson and Blount, on both sides of the Warrior River, and its several branches. Throughout all this area, seams of bituminous coal crop out, the number and thickness of which it has been impossible as yet to determine, as no regular survey has been commenced of this State. That there must, however, be many distinct seams, is evident, as I saw several different ones between 11 and 20 miles of Tuscaloosa, which had been worked with profit, and considerably farther to the northeast, three have been seen superimposed upon each other, the largest and lowest appearing in the bed of the Warrior River, and being no less than 10 feet thick.

The more eastern coal field, or that of the Cahawba, is nearly of equal length and breadth, terminating southwards at Centreville, where it meets the lower cretaceous beds, and extending from thence through Bibb, Shelby, Jefferson and St. Clair counties, to the sources of the Cahawba River. In this, also, numerous beds of coal of good quality have been detected, and some of them worked to a small extent.

From what I saw of the structure of the country between Tuscaloosa and Rook's valley, and from the facts communicated to me by Prof. Brumby, I have no doubt that a section passing from northwest to southeast, from the coal district of the Cahawba to that of the Warrior River, would present an additional axis along the line of the water-shed between the two rivers, where

the beds are highly inclined, and occasionally vertical, and the productive coal measures occur on both sides, their strata having a slight dip, and being in some places nearly horizontal. These views will best be explained by the annexed diagram.

Coal Fields of Alabama.



References.—*a*, Warrior river; *b*, Rook's and Jones' valley; *c*, Cahawba river. 1, Coal measures; 2, Grit; 3, Limestone and Chert; 4, Grit; 5, Coal measures. Length of section, 50 miles.

On the northern confines of the State of Alabama, there is a third coal field, that of the Tennessee valley, which is separated from the two former by a broad but low chain of mountains, which run nearly east and west, and intervene between the Tennessee and the sources of the Warrior and Cahawba rivers. These mountains, according to Prof. Brumby, consist of strata, like those before described as occurring immediately below the productive coal measures between the Warrior and Cahawba rivers, and consisting chiefly of quartzose grit and limestone. I could not ascertain whether this coal of northern Alabama, which runs about 100 miles east and west, along the Tennessee River, is actually continuous with the southeastern coal measures of the Apalachians, in the State of Tennessee, but it seems highly probable that they are united.

A careful comparison of the fossil plants of the Alabama coal field, which I have collected myself, or which have been liberally presented to me by Prof. Brumby, with those of the more northern coal fields, and of Europe, will be a subject of peculiar interest, as they are situated in lat. 33° 10′ north, and constitute, if I mistake not, the extreme southern limit to which the peculiar vegetation of the ancient carboniferous era has yet been traced, (in the northern hemisphere,) whether on the western or eastern side of the Atlantic.

ART. V.—*An attempt to refute the Reasoning of* LIEBIG *in favor of the Salt Radical Theory;* by ROBERT HARE, M. D., Prof. of Chemistry in the University of Pennsylvania.

Messrs. Editors—Agreeably to the notice given at the close of my last communication in this Journal, p. 82, I will proceed with my objections to Liebig's reasoning in support of the salt radical theory, commencing with another quotation from his lectures delivered at Geissen,* for that purpose.†

16. "*In one atom,*" *says the lecturer,* "*of a metallic oxide containing one equivalent of oxygen, this oxygen is replaced by one equivalent of chlorine, when brought into contact with an hydrogen acid. Take a metallic oxide containing two equivalents of oxygen, bring it into contact with an hydrogen acid, such as hydrochloric acid, what will be the chlorine compound produced? A corresponding metallic chloride. Take an oxide of the third class, (two atoms of metal, three atoms of oxygen,) what will be the product? A compound in which you will find two atoms of metal combined with three atoms of chlorine.*

M, O, M, Cl
M, O^2, M, Cl^2
M^2, O^3, M^2, Cl^3."

17. The facts mentioned in the preceding quotation, being represented by Liebig as justifying in inference that the proportions in which chlorine and metals combine, is due to the oxygen and hydrogen with which they may happen to be in combination, he proceeds thus to proclaim his impressions. "*Upon what, then, does the saturating capacity of the acid depend? Upon the hydrogen it contains. Upon what does the property of the base (of the metallic oxide) of neutralizing the acid depend? Upon the oxygen it contains.*" Thus the property of the halogen bodies, of forming neutral haloid compounds with metals, is not the consequence of the affinity for metals which they exert, when naked, but rests upon the fact that they *may have been, are now, or may hereafter be, severally in union with oxygen and hydrogen;* so

* The Lancet, (London,) Vol. II, No. 1090.

† Dr. Hare's second communication having been too late for insertion in the number for March, the whole is given in this number—that is to say, both the second and the conclusion.—*Eds. Am. Jour.*

that a mere liability to combine with these elements, endows them with a power to combine with other elements, of which power they otherwise would have been destitute. Liebig ascribes to hydrogen, not only the "*action of presence*," but an "*action of absence*" likewise. According to him, the halogen bodies owe their power of entering into union with metals, to the hydrogen which they contain, not only *when the element is present*, but to their susceptibility of uniting with it, whether *retrospectively* or *prospectively*. Let us see whether the phenomena on which these startling conclusions rest, are not susceptible of a more rational explanation.

18. When any radical unites in several equivalent proportions with any one electro-negative body, it will usually unite in the same proportions with other electro-negative bodies. This is in a great measure exemplified in the case of the oxides, sulphides and chlorides of iron; the oxides, sulphides and chlorides of tin and antimony. In like manner, the proportions in which oxygen enters into union with phosphorus and with arsenic are the same: also for every oxide of mercury we have a corresponding sulphide and chloride. But in some instances we have oxides of which there are no corresponding chlorides with the same radical. Thus in the instances of the metals potassium, sodium, calcium, barium and strontium, we may have peroxides but not perchlorides. Whenever the metal can form a perchloride, its peroxide, on due contact with the chloride of hydrogen, (muriatic acid,) is resolved into water and a perchloride. But when the metal is incapable of forming a perchloride like those above mentioned, peroxides are not convertible into perchlorides.

19. According to my apprehension, during the reaction of oxides with hydracids, so called, the hydrogen and oxygen only assist, by getting each other out of the way. In most instances, in which a chloride is generated by the meeting of an oxide with the chloride of hydrogen, it may be produced by presenting the metal to gaseous chlorine, *with* heat, if not *without*.

20. With respect to the peroxides of the metals of the alkalies and alkaline earths, it has been stated that the law here enunciated does not prevail; and I think it must be evident that the quantity of chlorine in the resulting chloride, is dependent solely on the affinity between chlorine and the metal. The hydrogen may resist this affinity when oxygen does not coöperate, as when

the metal is not oxidized; but even when present, hydrogen cannot be the cause or regulator of the affinity; and to suppose that when absent, it imparts affinity or capacity, strikes me as unreasonable. Was there ever a greater heresy in science, than this idea, that thirty-six parts by weight of chlorine, combine with forty of potassium, not because it is the nature of these elements to unite in these proportions, but because one of them *has been*, is now, or *may hereafter be* united by a much more feeble affinity to one part of hydrogen. With all due deference for the author, the efficiency attributed to hydrogen, by him, appears to me as unjustifiable as it is anomalous.

21. But is it with the chloride of hydrogen only that the binoxide of mercury will yield a bichloride? May not this last mentioned compound, the well known corrosive sublimate, be obtained by sublimation of the sulphate or nitrate of the binoxide of mercury with various chlorides?

22. It is assumed, by Liebig, in his lecture above mentioned, to be a general law, that the number of equivalents of acid requisite to saturate a base, is equal to the number of atoms of oxygen which it may contain. His words are: "one equivalent of oxygen in a base requires one equivalent of acid, two require two, three require three." In the next paragraph the fact is cited, that protoxide of potassium will take only one equivalent of acid to saturate it. But if the preceding allegation be true, how does it happen that the peroxide of potassium does not take even one equivalent of acid, unless by being resolved into a protoxide, so that the addition of oxygen, instead of producing the result which flows from this general law, actually has an effect diametrically opposite? The same allegation may be truly made of the peroxides of each of the metals of the alkalies or of the alkaline earths. Yet the protoxides of potassium and sodium *both unite with two equivalents of sulphuric acid.*

23. In the instances of lead, tin, antimony and manganese, the addition of oxygen beyond a certain amount, destroys the affinity for acids attendant on inferior degrees of oxidation, no less than in the instances above mentioned.

24. Among the evidences adduced by Liebig, as justifying the law above mentioned, is the fact, that in the persulphates of iron and chromium, two atoms of metal, taking three of oxygen to form a sesquioxide, one atom of the sesquioxide requires for

saturation three atoms of acid; but the reason why neither iron nor chromium can form a binoxide, is a mystery which is not represented as explicable agreeably to the new doctrine. As there can be no doubt that there is a common rationale of this fact, and of the analogous necessity of three atoms of acid to saturate two of the resulting sesquioxide, it follows that there is only one mystery to explain agreeably to the old view of the constitution of oxysalts; but this mystery exists just as much in relation to the new view, substituting oxysulphion or some other imaginary compound radical for oxygen. The mystery, in one case, is wherefore two atoms of mercury are capable of taking four atoms of oxygen with four of acid, when two atoms of iron can only take three of oxygen and three of acid. In the other case, the mystery is that two atoms of mercury should take four atoms of oxysulphion, while the same number of atoms of iron take no more than three.

25. In the cases above cited, hydracids in combining are made to abandon hydrogen; yet the oil of the Dutch chemists is represented by Liebig,* as a "*hydrochlorate of the chloride of acetyl*," in which muriatic acid is made to act as an acid, *in propriâ personâ*, without either losing or gaining hydrogen. In this instance, it would seem that the celebrated author had precisely the same view of an acid which has been heretofore generally entertained, *that it is a body that will combine with a base without decomposition.*

26. Agreeably to the language held by this great chemist respecting his hydracids, it would seem as if the essential character of acidity were an incapability of existence, excepting by being first united with hydrogen, and a susceptibility of being resolved into what Berzelius considers as a haloid salt, by being presented to oxybases. How, then, does it happen that this decomposition does not ensue on the presentation of the chloride of hydrogen to the hydruret of acetyl? How does it arrive that the hydrochloric acid forms chlorides with metals, while in this ethereal compound it forms a veritable hydrochlorate? Is it in the latter, or in the former case, that it has a true acid reaction? According to my apprehension, it is only in the latter that it acts as an acid, but not as a hydracid. It performs, as I infer, the part

* Liebig's Gregory's Turner, p. 896.

of a chloro-acid, and combining with a chloro-base, the resulting combination may be correctly called the chlorohydrate of the chloride of acetyl.

27. In the next place let attention be given to the inquiries contained in the following language of Liebig.

"*But how, we may ask, are these so-called anhydrous acids known? Can we exhibit them without this water of hydration? The following strange answer is returned to this question by the adherents of this theory:—the innumerable acids which we call anhydrous, exist only in imagination; they are quite unknown; they cannot be shown to you.*"

28. Although agreeably to Liebig's work upon organic chemistry, nature is prolific of compound radicals, which for the most part have never been isolated, although *none* of those whose existence is assumed by the salt radical theory have been isolated, yet agreeably to his language above given, the fact that *some* of the anhydrous oxacids cannot be isolated, is treated as an objection fatal to their existence altogether.

29. The decomposition of chlorate of potash in aqueous solution, by sulphate of the protoxide of iron, is represented as a case in which protoxide of iron overcomes the affinity of potassium for oxygen, treating the paramount affinity of chlorine for that metal as a consideration which could only be insisted on "*for the sake of argument.*"

30. Agreeably to the salt radical theory, in each of the oxysalts, of which the reaction is the subject of the preceding paragraph, there is a salt radical, (oxysulphion in the sulphate, oxychlorion in the chlorate,) yet chloride of potassium is the result of the process, no less than if potash were subjected to muriatic acid. Admitting that in the reaction of this last mentioned acid, the formation of the resulting chloride is due to hydrogen, how comes it that notwithstanding the absence of this *capacity giving* element, we obtain a chloride of potassium? What indication is there of the presence of oxychlorion or oxysulphion?

31. The resolution of sulphate of potash and cyanide of potassium, when fused together, into cyanate of potash and sulphuret of potassium, is by Liebig mentioned as an instance in which "*potassium reduces potash,*" an inference which is erroneous: first, because potassium cannot take oxygen from its own protoxide; secondly, because the affinity of the sulphur for that

metal, the most powerful force engaged in the whole process, is overlooked; and thirdly, because the potash is not reduced, but on the contrary, unites with the cyanic acid formed by the union of the oxygen of the sulphuric acid with cyanogen.

32. Under the circumstances in question, agreeably to the old doctrine, three atoms of oxygen, one of sulphur, one of cyanogen, one of potassium, and one of potash are present. The sulphur seizes the potassium, the oxygen for the most part unites with the cyanogen, forming cyanic acid, which combines with the potash. This is just what ought to take place, consistently with the premises.

33. But according to the new doctrine, the agents being one atom of oxysulphionide of potassium, and one atom of the cyanide of the same metal, the result is precisely such as to justify the impression, that the pre-existence of oxysulphion in the sulphate, and the generation of oxycyanion in the resulting cyanate, are imaginary.

34. It is advanced by Liebig, agreeably to a table which he gives, that there are seven salt radicals, consisting of sulphur variously oxidized; and it is remarkable, that anhydrous sulphuric acid SO^3, is treated as the compound radical of sulphurous acid. Were this correct, anhydrous sulphuric acid ought to produce sulphites on contact with metals in the metallic state.

35. Alluding to the old opinion of the constitution of salts, Liebig inquires: "*upon what does the power of saturating an oxygen acid depend, according to this theory: whence proceeds neutrality? Why is it necessary that for every equivalent of oxygen in the oxide, an additional equivalent of the so-called anhydrous acids must be present?*"

Replying to the latter of these inquiries first, I refer to the facts above adverted to by me, (par. 22,) that in the case of the peroxides of the metals, of the alkalies and alkaline earths, each additional atom of oxygen does not give the power of combining with an additional equivalent of acid. Moreover in the case of the metaphosphates adduced by the author, an oxide in the tribasic phosphate has the power, without any addition of oxygen, to unite with three times as much acid as in the monobasic phosphate.

36. I will also again call attention to the fact, that although neither the peroxide of potassium nor that of sodium, will unite

with even one equivalent of sulphuric acid, either of the protoxides of those metals may combine with two equivalents of that acid, so energetically as to be fusible without decomposition into a dry mass: I allude here especially to the well known bisulphate of potash. I have already animadverted upon the fallacy of assuming that muriatic acid gives a bichloride on meeting with a bioxide, only in consequence of the presence of two atoms of oxygen in the latter, (17, &c.)

37. There does not appear to me to be any more difficulty in assigning a reason for the union of an oxybase with an oxacid, than in accounting for the union of the radicals, entering respectively into their composition, with oxygen.

38. The more any two bodies differ in their electro-chemical habitudes, the greater is their reciprocal affinity. Hence as potassium is strongly electro-positive, while oxygen is strongly electro-negative, they unite with an energetic affinity. But as potassium is more electro-positive than oxygen is electro-negative, in combining with oxygen it produces an electro-positive oxide. On the other hand, oxygen being more electro-negative than sulphur is electro-positive, on combining with it forms oxides which are electro-negative. Hence an affinity prevails between the oxacids of sulphur and the oxybase of potassium, which though less energetic than those existing between oxygen and sulphur, is founded on a similar electro-chemical diversity.

39. "*Do you find*," says Liebig, "*any of the characteristic properties of hydrogen acids in chromic acid, boracic acid, silicic acid, titanic acid, or their combinations with oxides?*"

40. In the interrogation here quoted, the author of a new, vague, and undefined idea of acidity, appeals to that idea in support of a nondescript innovation.* Is it not surprising, that it should not be perceived, that the enquiry would be more justifiable if reversed, and that all claims to the acid character on the part of the hydrurets alluded to, might be denied upon the ground that they are deficient of that all-important property of combining with oxybases, on which the claims of oxacids to the acid character has been considered as dependent? In consequence of the deficiency of this attribute, the quadroxide of nitrogen NO^4, has been treated of by Berzelius, as unworthy of a place in the

* See this Journal for January, 1486.

class of acids; and in a letter to me this great chemist admitted, that he had been inconsistent in overlooking this deficiency in the case of the hydrogen acids or "hydracids," erroneously so called.

41. That the oxacids enumerated in the words last quoted, should have none of the properties of hydrogen acids after presentation to oxides, is precisely what occurs when hydrogen acids are presented to oxides agreeably to the following allegation of Liebig, "*the hydrogen compounds possess an acid character which is destroyed by the substitution of a metal for hydrogen.*" Thus the oxides are expected to acquire in combination, properties of hydrogen acids, which under circumstances treated as analogous by the author, those acids do not themselves retain, agreeably to his own representations.

42. Liebig enquires, how, consistently with the old doctrine, is it to be explained, "that the amount of oxygen *in a base*, determines its power of neutralization." Having shewn that it does not have this effect in the instance of oxides formed with some of the most energetic metals, (18,) I beg to know how it is that the amount of hydrogen which is not in union with a body, can regulate its susceptibility of neutralization? (20.)

43. Again, "*we want to know*," says Liebig, "*upon what constituent of the acid its capacity of neutralizing the alkaline properties of bases depends.*" In reply to this query, I would ask, what reason is there for supposing, that the property of neutralization is dependent on any constituent in particular? Agreeably to my opinion, this property depends upon an electro-chemical diversity existing between the electro-negative element and the electro-positive radicals, severally of the acid and base. This diversity is not so completely neutralized by the chemical union to which these compounds owe their existence, as not to leave between them an analogous diversity sufficiently powerful to endow them with that difference of relation to the voltaic poles, which is the only true and universal test of what I would call acidity and basidity. It is thus that I would account for the power of oxacids and oxybases to unite so as to produce to a greater or less extent reciprocal neutralization.

44. Agreeably to Liebig, "*salts are combinations of simple or compound radicals with metals, corresponding in composition with the degrees of oxidation of the latter.*" If there be

any known compounds which are preëminently entitled to be designated as salts, would it not seem that chloride of sodium and those of the haloid compounds which are its congeners in properties and composition belong to that class? I have however objected to extending the designation to such haloid compounds as utterly differ from chloride of sodium in properties, however analogous in composition; such for instance, as the fuming liquor of Libavius, the butyraceous chlorides, plumbum corneum, luna cornea, fluoride of calcium, and the gaseous haloid hydrurets, treated as hydracids by Liebig. It has appeared to me that a salt properly means a body having some analogy in properties with common salt, the original type of the genus. I have urged that there were oxides, in this respect, more entitled to be considered as salts than some of the compounds formed by the salt-producing class of Berzelius. But according to the definition above quoted, common salt, chloride of sodium, is a salt only because it contains the same number of equivalents of chlorine that sodium does of oxygen; and the haloid congeners of common salt, are salts only because their metals unite with oxygen, in the proportion in which their halogen ingredient enters into their composition. Were oxides viewed as salts by Liebig, there might be some consistency in considering other bodies as salts so far as they might have an analogous composition, but in the actual state of the case the definition seems to be unjustifiable. Under this definition how are the sulphides, selenides, tellurides, phosphurets and carburets, to be excluded from the class of salts when consisting of a metal, united with either sulphur, selenium, tellurium, carbon, or phosphorus, in the same proportion as oxygen is capable of combining with the same metal?

45. Liebig refers to the electrolytic experiments of Daniell for support, but those were sufficiently shown to be nugatory, in an essay published in the American Journal of Science and Arts, vol. xlv, for 1843. See also, L. E. Phil. Mag. vol. xxiii, p. 203.

46. It would indeed be miraculous, if all the seven compound radicals existing in the oxacids of sulphur, according to the table above alluded to, should prove to be anions, on subjecting their compounds to electrolysis.

47. There is something in the reaction of muriatic acid with alumine and likewise magnesia, and of water with chloride of aluminium, through which an appeal is made in favor of the ex-

istence of salt radicals. I shall not however prolong the discussion, and render it more abstruse and unpalatable, by entering upon these mysteries. I have said enough to prove that the new doctrine is founded in misapprehension and false reasoning; and should there be some difficulties agreeably to the old doctrine, it is pretty evident that the salt radical theory will not enable us to get out of them.

ART. VI.—*Notice of a new genus of Plants, of the order Santalaceæ;* by ASA GRAY.

(Read before the Boston Natural History Society, March 18th, 1846.)

THE incomplete characters of the plant which is the subject of the present communication, are now published mainly in the hope, that by directing the attention of local botanists towards it, the information which is still needed may be the sooner obtained.

My earliest knowledge of the plant in question, was derived from some specimens in the herbarium of the late Zaccheus Collins, Esq., now belonging to that zealous botanist, Mr. Elias Durand. The specimens were ticketed, "Milledgeville, Georgia, from Dr. Boykin." If they were communicated to Mr. Collins himself, as appears to have been the case, Dr. Boykin was, so far as I can learn, the discoverer of the plant, though perhaps not aware of its interest, since it has not again occurred in the collections of the plants of Georgia, which he has so liberally distributed among northern botanists. It was in the spring of the year 1842 that these specimens fell under my observation, through the favor of Mr. Durand, who obligingly furnished me with a portion of them. They are leafy branches of a shrub, with staminate flowers only.

My next information was received from my friend and correspondent, the Rev. M. A. Curtis, of North Carolina, who, in the summer of 1839, near Lincolnton in that State, noticed a shrub quite new to him, but destitute of any vestiges either of flowers or fruit. Having seen a leafy specimen, I have no doubt of its identity with the plant above mentioned. Mr. Curtis revisited the locality last summer for the special purpose of ascertaining what this unknown shrub could be. He was disappointed, how-

ever, being unable to find a single plant of the kind over the whole ground, where it was quite abundant six years ago.

It was with great pleasure that I met with a specimen of this plant, for the third time, in February last, in a small but interesting collection made around Macon, Georgia, by Professor J. Darby, the author of a good elementary treatise on "Southern Botany," and the former principal of a seminary of high character at that place, but who has recently accepted the mathematical chair in Williams College, Massachusetts. The unticketed specimen is finely in blossom, but, much to my disappointment, the flowers all proved to be staminate.

Still, the materials in my possession, imperfect as they are, suffice to show that the shrub in question belongs to the small and highly interesting order of *Santalaceæ*, and that it is nearly allied to the genus *Comandra* of Nuttall. With my present information, I know of no other genus with which it may be immediately compared.

In inflorescence it agrees with Comandra, except that the peduncles are axillary, and the short pedicels strictly umbellate. The calyx, disk and stamens are quite similar, and above all, the anthers are connected with the lobes of the perigonium by the same singular tufts of cobwebby hairs. The observed points of difference are, first, that this new plant is apparently diœcious. The staminate flowers do not exhibit the slightest trace of a gynæcium. The turbinate calyx-tube is accordingly hollow to the very base, and is lined with the thin disk throughout. In the second place, the present plant is a shrub, though attaining to the height of only one or two feet, and presenting somewhat the aspect of a Viburnum; while the two species of Comandra are low herbs, with at most a suffrutescent base; and thirdly, what is of more importance, the leaves, which are alternate in Comandra, are uniformly opposite in our plant. They may perhaps be compared with those of some *Prinos*, or of *Nemopanthes*, Raf. (Ilex Canadensis, *Michx.*) except that they are mostly acute at both ends.

On applying to Professor Darby for further information, I learn that this shrub has been to him an object of special interest for the last ten years, although he has never found it except upon one spot, only a few rods square, where it is abundant, forming bushy shrubs, two or three feet in height. The pistillate flowers

appear to be very scarce. In August, 1841, however, Mr. Darby obtained the unripe fruit, which, he remarks, is "baccate, one-celled, one-seeded, apparently inferior, but there is no cohesion of the ovary with the calyx: style one." Mr. Darby had regarded the plant as probably a new genus, but, on account of its free calyx, (having also apparently overlooked the tuft of hairs, &c., in the staminate flowers, which indicate its close relationship to Comandra,) he had referred it to the wrong natural order. Indeed, if the calyx-tube does not cohere with the ovary, an unexpected anomaly in the character of the order Santalaceæ is here presented. We are at present unable to verify this point, Mr. Darby's fruiting specimens having recently been lost by shipwreck, along with many other invaluable specimens and notes, on their way from Georgia.*

In directing the attention of the botanists of upper Carolina and Georgia to this interesting shrub, I would specially request that the pistillate flowers and young fruits may be preserved in spirits, in order, not only that the peculiarity already alluded to may be satisfactorily determined, but more particularly, that the structure of the ovula and the fecundation, so peculiar in this natural family, may be duly studied. For the same reason, specimens of the pistillate flowers of *Pyrularia*, Michx., (the *Hamiltonia* of Muhlenberg,) and also of *Buckleya*, Torrey, preserved in spirits, are particularly desired by the writer.

As I have no doubt that this shrub adds another to our few genera of this interesting order, I am desirous that it should bear the name, and commemorate the botanical services and zeal of Prof. Darby, one of its discoverers, to whom a large part of our still incomplete knowledge of it is mainly owing. I append, therefore, its technical characters, as at present known.

DARBYA, *Gen. Nov. Ord.* Santalaceæ.

Flores dioici. *Masc.* Perigonium simplex, turbinatum, ad medium 4–5-fidum; lobis ovatis patentibus. Discus crassiusculus,

* In answer to a particular inquiry, Mr. Darby informs me, by letter, that his memory is not positive as to the want of cohesion between the calyx and the ovary, and that some notes made with the plant before him, were lost with the fruiting specimens. He remarks, also, that the mature fruit was not soft and pulpy, as he supposed from the earlier stage it would prove to be. It is therefore probably similar in texture to that of Pyrularia, or Buckleya, or perhaps even dry, like that of Comandra.

perigonii penitus tubo adnatus, margine 4–5-crenatus. Stamina 4–5, e sinubus disci, lobis perigonii opposita: filamenta brevia, subulata: antheræ biloculares; loculis fasciculo filarum araneosarum ad basim lobi perigonii annexis. *Fœm.* ignota. Fructus . . . . . stylo unico superatus, unilocularis, monosspermus. Frutex in Georgia et Carolina Superiore vigens, glaber, cortice griseo. Folia opposita, uncialia, membranacea, ovalia, margine integerrima subundulata, breviter petiolata, venosa, subtus pallidiora. Pedunculi axillares, solitarii, folio breviores, ebracteolati, umbellam 3–8-floram gerentes; floribus parvis virescentibus, intus flavidis.

Sp. DARBYA UMBELLULATA.—Hab. Near Milledgeville, Georgia, *Dr. Boykin*, and at Macon, *Prof. Darby:* also at Lincolnton, North Carolina, *Mr. M. A. Curtis.*

I intended here to record some observations made last season upon the ovula and fecundation of Comandra, which, although exhibiting the same general plan as in Thesium, according to the investigations of Decaisne, appear to differ considerably in some particulars. But as the season approaches when I may be able to repeat and extend the examinations, these remarks are for the present deferred.

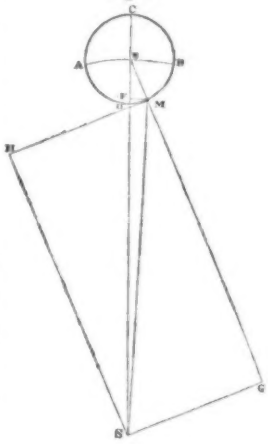
ART. VII.—*Variation, or the alternate Acceleration and Retardation of the Moon in the different quadrants of its orbit;* by JAMES H. COFFIN.

IN the year 1590 Tycho Brahe, a Danish nobleman and a zealous astronomical observer, discovered the fact that the moon moves faster when it is new or full than at other times, and slowest when it is midway between these points, or in quadrature, and consequently that it is alternately accelerated and retarded in alternate quadrants of its orbit. This inequality we denominate *variation*. The cause of it was not known till the discovery of the principle of universal gravitation by Sir I. Newton, when it was shown to be a necessary consequence of the sun's attraction.

In an article on the *secular acceleration of the moon's mean motion*, published in the Journal of Science and Arts for October, 1844, it was shown that if we take the quantity of matter in the earth as the unit by which to measure other quantities of matter,

and its attraction on the moon at the mean distance as the unit by which to measure other attractive forces, the quantity of matter in the sun would be 354936, (which number we call S,) and its mean attraction on the moon during a lunar revolution $\frac{S \times EB^2}{SE^2}$, (fig. 1.)

Fig. 1.



The whole attractive force of the sun upon the moon at any point M of its orbit was represented by the letter m, and was resolved into two others in the directions ME and ES. The expression for the disturbing force in the latter direction was shown to be $\frac{3EF}{SM}m$, which was again resolved into two others in the directions EG and GS or MH. For the former of these, known in astronomy as the *ablatitious* force, we obtain the expression $\frac{3EF^2}{SM \times ME}m$. The latter, which we are now to examine, is called the *tangential* force, because it acts in the direction of a tangent to the moon's orbit at the point M.

The proportion for obtaining it will read ES : SG, or by similar triangles, CM : MF :: $\frac{3EF}{SM}m$: the tangential force = $\frac{3(EF \times MF)}{SM \times EM}m$. By the principles of trigonometrical analysis, $EF \times MF = \frac{1}{2}EM \times \sin 2MED$. Substituting this value in the place of $EF \times MF$, the expression for the tangential force becomes $\frac{1\frac{1}{2}EM \times \sin 2MED}{EM \times SM}m = \frac{1\frac{1}{2}\sin 2MED}{SM}m$. Owing to the great distance of the sun, all the terms in this expression are nearly constant, while the moon is passing through a quadrant, except sin2MED. Consequently the tangential force must be nearly proportional to this term, and the others may be taken at their mean value. The mean value of m we have given above $= \frac{S \times EB^2}{SE^2}$, and that of SM is evidently SE.

When MED = 45°, and consequently 2MED = 90°, its sine becomes EB, and the expression for the tangential force becomes $\frac{1\frac{1}{2}\text{EB}}{\text{SM}}m$. Or by giving to m and SM their mean values it becomes $\frac{1\frac{1}{2}\text{EB}}{\text{SE}} \times \frac{\text{S} \times \text{EB}^2}{\text{SE}^2} = \frac{1\frac{1}{2}\text{S} \times \text{EB}^3}{\text{SE}^3}$.

Restoring the numerical value of S, viz. 354936, and giving to EB and SE their mean values, viz. EB = 237577 miles, and SE = 95024608 miles, the value of the expression last found becomes ·008306625. Its mean value through each octant must be proportional to the mean sine in a quadrant, which is the sine of 39° 28′ nearly = ·63563. Hence, 1 : ·63563 : : ·0083066 : the mean tangential force in an octant or a quadrant, which is thus found to be ·00528.

Increments or decrements of velocity are proportional to the forces that produce them, and consequently the total velocity acquired or lost is proportional to the sum of the forces, whether they be uniform or variable in their operation. Hence the amount which the moon gains or loses in velocity while passing through a quadrant, is precisely the same as it would be if the tangential force remained all the while in its mean state; and to see more clearly what this amount is, let us compare the tangential force with some other, with whose accelerating power we are familiar.

The force of gravity at the earth's surface, we know, draws a body $16\frac{1}{2}$ feet per second, or 57,900 feet per minute, thus creating in one minute a velocity of double that amount, or 115800 feet per minute. But as the moon is about $60\frac{1}{3}$ times as far from the center of the earth as the earth's surface is, the diminished force of gravity at that distance would give a velocity only about $\frac{1}{3\,6\frac{1}{3}\,6}$ as great, or about $32\frac{1}{9}$ feet per minute. The mean tangential force being ·00528 of the earth's attraction on the moon, will create a velocity of only this fraction of $32\frac{1}{9}$ feet per minute, which is equal to about $2\frac{1}{3}$ inches. Multiply this by $5315\frac{1}{2}$, the number of minutes it takes the moon to describe a synodical octant,* and we obtain about 904 feet per minute, as the velocity

* The term octant is not strictly true, for by reason of the earth's progressive motion in its orbit, the moon describes an arc of 97° 16′ 35″ in passing from syzygy to quadrature or from quadrature to syzygy, and consequently there is 48° 38′ $17\frac{1}{2}$″ in the arc which we have called an octant. We employ the term for the sake of conciseness.

acquired or lost by the moon while passing through an octant, which must be the amount by which its velocity exceeds the mean in syzygy, or falls short in quadrature. The mean rate of the moon's motion in its orbit being about 200224 feet per minute, the velocity in syzygy must exceed the mean by about $\frac{9}{2}\frac{0}{0}\frac{4}{2}\frac{2}{4}$ or $\frac{1}{2}\frac{1}{2}\frac{1}{2}$, and that in quadrature fall short by the same fraction. Consequently, so far as the cause we have now considered is concerned, the numbers 221, 222, and 223 are proportional to the velocity in quadrature, the mean velocity, and the velocity in syzygy.

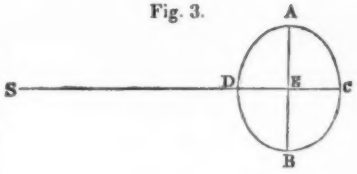
We have thus far supposed the moon's orbit to retain its circular form, notwithstanding the disturbing influence of the sun; but this is not possible. To retain a body in a circular orbit, the centripetal and centrifugal forces must be equal. But we have just shown that the velocity in syzygy is greater than in quadrature; and as the centrifugal force is proportional to the square of the velocity, it must also be greater. On the contrary the expression for the ablatitious force, viz. $\frac{3EF^2}{SM \times ME}m$, becomes 0 when the moon is in quadrature at A or B, but is increased when it is in syzygy at C or D so as to become $\frac{3ME^2}{SM \times ME}m = \frac{3ME}{SM}m$. On giving to m and SM their mean values, as found above, the expression becomes $\frac{3S \times ME^3}{SE^3}$. It will be seen by a comparison of the terms, that this is just double the maximum tangential force, and as the numerical value of that, expressed in decimals of the moon's mean gravity towards the earth, was ·008306625, this must be ·01661325, or about $\frac{1}{6}\frac{'}{0}$. Consequently the moon's gravity toward the earth at A or B is to its gravity at C or D in the ratio 60 : 59.

The force of gravity being thus diminished, and the velocity increased when the moon is in syzygy, the centrifugal force exceeds the centripetal, which causes the moon's track to fall without the circle, as to F and G, (fig 2.) But when the moon is in quadrature the centripetal force exceeds the centrifugal, causing it to fall within its circular orbit as to L and N.

Fig. 2.

The effect is to throw the orbit into something such a shape as is represented in fig. 3, viz. a kind of oval, with its longest diameter, AB, at right angles to the line ES, drawn from the earth to the sun.

Fig. 3.



By this change both the moon's gravity toward the earth, and its velocity, are still farther affected; its gravity because its distance from the earth being not now the same in all parts of its orbit, the attractive force of the latter varies in the inverse ratio of the square of the distance; and its velocity because the direction of its motion being rendered oblique to the radius vector, the earth's attraction conspires with the tangential force of the sun to accelerate it while passing from quadrature to syzygy, and retard it while passing from syzygy to quadrature. Indeed so far as the attractive force of the earth is concerned, being directed toward a fixed point, the moon describes equal areas in equal times about the earth as a centre, and consequently the velocity at C or D : the velocity at A or B : : EA : ED.

There are two reasons then why the velocity of the moon is greater in syzygy than in quadrature; 1st, the tangential force of the sun, which increases it in the ratio 221 : 223; and 2d, the oblique action of the earth's attraction on the moon in its disturbed orbit, which increases it in the ratio ED : EA. Hence from both combined it is increased in the ratio $221 \times ED : 223 \times EA$.

There are also two causes which affect the moon's gravity toward the earth; 1st, the ablatitious force of the sun, which makes it less in syzygy than in quadrature in the ratio 60 : 59; and 2d, the unequal attraction of the earth in the disturbed orbit, which makes it greater in the ratio $ED^2 : AE^2$. Hence from both combined, the gravity in quadrature : the gravity in syzygy : : $60 \times ED^2 : 59 \times EA^2$.

A near approximation to the shape of the oval, or to the ratio between its least and greatest diameters, can be determined without much difficulty.

It is a law of central forces that the radii of orbits are proportional to the square of the velocity divided by the centripetal force. Hence the moon's orbit at C and D must be described with a longer radius than at A and B, in the ratio $\frac{(223 \times EA)^2}{59 \times EA^2}$:

$\frac{(221 \times ED)^2}{60 \times ED^2}$, or about 672 : 649. If it be inquired how the radius can be longer and yet the moon nearer the earth, we reply that owing to the disturbing influences that we have been considering, the moon does not revolve around the earth as a centre, but round a point more distant at C and D, and less so at A and B.

As this oval is very nearly an ellipse we may regard it as possessing its properties, considering AB as the transverse and CD the conjugate axis. Now it is proved in works on the conic sections, that the radius of curvature at any point in an ellipse is proportional to the cube of the diameter conjugate to that which passes through that point. Hence, $AB^3 : CD^3$ :: the radius of a circle having the same curvature as the oval at C or D : that of one having the same curvature as the oval at A or B. But these radii we have proved to be to each other in the ratio 672 : 649; therefore $AB^3 : CD^3 :: 672 : 649$, and $AB : CD :: \sqrt[3]{672} : \sqrt[3]{649}$ :: 1 : 1·0117. Sir I. Newton and after him other astronomers have resolved the problem with more accuracy than is here attempted, taking into account some minor circumstances that we have disregarded, and make the ratio 1 : 1·0147, or about 68 : 69.

It has been already shown that the absolute velocity of the moon in quadrature : its absolute velocity in syzygy :: 221 × ED : 223 × EA. But adopting Sir I. Newton's result, ED : EA :: 68 : 69; therefore the absolute velocity in quadrature : the absolute velocity in syzygy :: 221 × 68 : 223 × 69 :: 15028 : 15387. And the difference of the apparent or angular velocity is still farther increased in the ratio 68 : 69, by reason of the diminished distance of the moon from the earth when in syzygy. Hence, from all causes combined, the angular velocity in quadrature : the angular velocity in syzygy :: 15028 × 68 : 15387 × 69 :: 51 : 53 nearly; and the numbers 51, 52, and 53 are proportional to the velocity in quadrature, the mean velocity, and the velocity in syzygy.

The moon's mean horary motion is 1977″; hence according to our calculations it must exceed that in syzygy by 38″, and be less in quadrature by the same amount. According to the most accurate observations the difference is about 41″.

ART. VIII.—*Observations on the Eocene formation of the United States, with descriptions of species of Shells occurring in it;* by T. A. CONRAD,—(with plates.)

(No. 2. Continued from page 221.)

CRASSATELLA.

THIS genus is not recognized with certainty in deposits older than those of the Cretaceous strata, in which I discovered two species in New Jersey. Five occur in the American Miocene, but the Post-pliocene contains none, nor is there a recent species known to inhabit the coast of North America. Deshayes enumerates twenty-four species in the tertiary formations of Europe; fourteen of which are in the Paris Eocene.

CRASSATELLA ALTA. Suborbicular, thick and ponderous, slightly ventricose above, somewhat compressed inferiorly; surface with coarse lines of growth, beaks submedial, separated; umbo transversely sulcated towards the summit; dorsal margins equally and profoundly oblique; posterior margin direct, truncated; posterior dorsal area profoundly depressed; lunule large, elliptical, very profound, deepest at the anterior extremity; cardinal plate profoundly dilated, the fosset extending not more than half the width of the hinge plate; in the left valve, behind the large tooth and beneath the fosset, is a deep triangular cavity; inner margin crenulated. (Plate III, fig. 1.)

C. alta, Con.; Foss. Shells of Tert. Form., p. 31, plate vii. Desh., Lam.; Anim. sans Vert., vol. vi, p. 116.

Claiborne, Alabama.

This large species is allied to *C. tumida*, Lam., an Eocene fossil of the Paris basin. It is proportionally more elevated, and Deshayes remarks that the hinge is less strongly articulated. It is common at Claiborne, and rarely occurs with connected valves. I found casts of this shell near Long Branch, N. J., where a bed of infusorial earth of Eocene date also occurs.

CRASSATELLA PROTEXTA. Somewhat elliptical, elongated; lower half of the valves sulcated; umbo and beak with fine, closely arranged regular sulci; valves somewhat contracted anteriorly, tumid on the posterior part of the umbo; umbonial slope prominently folded; posterior slope rugose; posterior extremity obliquely truncated; umbo carinated on the umbonial slope; basal

margin sinuous; inner margin finely crenulated. (Plate III, fig. 2.)

C. protexta, Con.; Foss. Shells of Tert. Form., p. 22, plate viii, fig. 2.

Claiborne, Alabama.

A very abundant species, rarely found with united valves. It is variable in form, and very young shells have the whole disk sulcated; they are proportionally much shorter than adult specimens, and of a trapezoidal outline.

Plate III, fig. 4, represents outlines of two varieties of the immature shell.

Crassatella alæformis. Oblong-ovate, convex, with distinct lines of growth, which towards the anterior margin become regular, prominent striæ; umbo and beak flattened and profoundly sulcated; anterior margin of the umbo gibbous; posterior side produced, cuneiform, obliquely truncated at the extremity; umbonial slope somewhat angulated; lunule elliptical, profound; inner margin finely crenulated. (Plate III, fig. 3.)

C. alæformis, Con.; Jour. Acad. Nat. Sci., vol. vi, p. 228, plate x, fig. 1.

Piscataway, Prince George's Co., Maryland.

I found a single valve of this species in 1830 in the sandy marl, or mixture of siliceous sand, clay and green sand, where it accompanies Cardita planicosta and many other Eocene shells. I have since obtained two more valves, and find the outline to be very uniform in this species.

Crassatella rhomboidea. Oblong, rhomboidal; anterior margin obliquely subtruncated at base; posterior margin obliquely and widely truncated, the inferior extremity rounded; posterior dorsal margin not very oblique; basal margin slightly curved. (Plate III, fig. 5.)

Orangeburg, S. C.

This is a cast in indurated clay, presented by Dr. Wm. Blanding. The outline is more perfectly rhomboidal than in any other American species. Mr. Vanuxem obtained similar specimens in the same district of South Carolina.

Crassatella palmula. Ovato-trigonal, profoundly compressed, the umbo almost rectilinear; dorsal margins very oblique, equally declining, the ligament margin straight; the anterior margin swelling slightly; apex nearly central; posterior extremity truncated? (Plate IV, fig. 1.)

Upper Marlborough, Prince George Co., Maryland.

A single imperfect valve is all I found of this species. It is remarkably flat, particularly over the umbo. It was imbedded in a hard rock or indurated marl, and is composed of crystallized carbonate of lime.

Amphidesma.

The oldest known species of Amphidesma of Lamarck, occur in the Eocene. Only one fossil species was known to Deshayes when he published his table in 1833. In the American Eocene I find three species; in the Miocene, eight; and two recent ones occur on the Keys of Tampa bay, Florida.

Deshayes supposed this to be an artificial genus as grouped by Lamarck; but of all the bivalve genera, we know none more natural and easily recognized, considered in reference to American species; although in some there are lateral teeth, in others none, and some species have them in one valve only. The most striking character is the very oblique, elliptical or oblong fosset. Perhaps the genus might rank next to *Mesodesma* in the family Mactridæ.

Amphidesma linosa. Ovate, plano-convex with fine regular concentric prominent lines; right valve with a somewhat prominent obtuse fold over the umbonial slope, the base of which is emarginate; posterior side short; extremity subtruncated or very obtusely rounded, direct; beaks slightly prominent; fosset produced, elliptical. (Plate IV, fig. 2.)

A. linosa, Con.; Foss. Shells of Tert. Form., p. 42.

Claiborne, Alabama.

I have only two valves of this species, which much resembles a Tellina exteriorly. The palleal sinus is very profound. In the right valve are two diverging compressed cardinal teeth, and the lateral teeth are very distinct.

Amphidesma tellinula. Subovate or subtriangular, thin, ventricose; dorsal margins very oblique, the posterior one rectilinear; posterior side narrower and rather shorter than the anterior, extremity truncated and very much above the line of the base; basal margin profoundly rounded; cardinal tooth double; fosset small; lateral teeth obsolete. (Plate IV, fig. 5.)

Claiborne, Alabama.

Of this species I have but one left valve. The fosset of the hinge is shorter than is usual in the genus, and much less oblique

or more direct; the tooth which is anterior to the fosset is double, and before it there is a minute pit; posteriorly, the hinge has a narrow elliptical depression or lunule, which gives the shell the appearance of a lateral tooth.

Corbula.

Corbula of Lamarck is a very ancient genus. I found one species in the Silurian rocks of New York. Others occur in the Carboniferous limestones of Europe, in the Lias, Oolite, green sand and Gault. In the Tertiary, Deshayes enumerates thirty five species. I have not observed the genus in the Cretaceous strata of this country. I find two in the Eocene, and four in the Miocene. One recent species inhabits the coasts of Massachusetts and the Carolinas, (*C. contracta*, Say,) which occurs also in the Post-pliocene of Maryland; and another recent species I obtained from a sounding lead in deep water in the Gulf of Mexico.

Corbula nasuta. Ovate-trigonal, ventricose, concentrically striated; beaks medial; posterior extremity of larger valve rostrated, the extremity obliquely truncated; umbonial slope of both valves carinated. (Plate IV, fig. 4.)

C. nasuta, Con.; Foss. Shells of Tert. Form., p. 38, Aug. 1833.

C. Alabamiensis, Lea; Cont. to Geol., p. 45, plate i, fig. 12, Dec. 1833.

Claiborne, Alabama.

The valves of this common species are nearly equally convex, and the striæ on both valves about equal in size and approximate. In some specimens the basal margin is slightly contracted. The valves are suddenly rounded or curved inwards towards the base.

Corbula oniscus. Triangular, profoundly ventricose, larger valve with concentric acute prominent striæ, profound on the back, obsolete towards the extremities; umbonial slope carinated, terminal, the posterior slope or area being profoundly depressed and carinated; posterior end suddenly rostrated, rostrum reflected, extremity truncated; lesser valve with numerous concentric wrinkled approximate lines, and carinated near the posterior extremity; beaks submedial. (Plate IV, fig. 3.)

C. oniscus, Con.; Silliman's Amer. Jour. of Science, vol. xxiii, p. 342, Jan. 1833. Lea.; Cont. to Geol., plate i.

Claiborne, Alabama; Washita river, Louisiana.

This species is common at Claiborne, and is remarkably like *C. angustata*, Sow.; and is also allied to *C. ombonella*, Desh., a fossil of the Paris Eocene. It was by means of this species that I was able to recognize an Eocene deposit on the Washita river, Louisiana, as it adhered imbedded in sand to the Zeuglodon bones sent from there. At Claiborne it is occasionally found with united valves.

One right valve much larger than usual, from Claiborne, has much more numerous, proportionally smaller, and more approximate and unequal concentric striæ.

Tellina.

The genus *Tellina*, Lin., is supposed to be as ancient as the Oolitic period. Mr. Phillips describes a species of the Coral Rag, but its generic character is uncertain. Deshayes's table gives fifty four tertiary species; eighteen in the Paris Eocene; four in the London clay, and four in the English Miocene. I have discovered five in the American Eocene and five in the Miocene, one of which is a recent speces, (*T. lusoria.*) Two recent species inhabit the coast of Massachusetts, and a few others are known on the southern coast. I found five species in Tampa Bay, Florida. The common *T. radiata* inhabits the eastern coast of Florida as far north as Fort Lauderdale, above Cape Florida.

Tellina Sillimani. Subtriangular, compressed, thin; left valve with a prominent acute fold over the umbonial slope, which is straight; posterior side shorter than the anterior; the dorsal line straight and oblique; the end margin obliquely truncated, and the extremity truncated; surface marked with brown concentric bands; valve contracted widely from beak to base between the middle and umbonial slope. (Plate IV, fig. 9.)

Claiborne, Alabama. Very rare.

Tellina papyria. Elliptical, subequilateral, very thin and compressed, with minute regular concentric impressed lines, obsolete on the posterior side; anterior end acutely rounded; posterior extremity angulated; beaks scarcely prominent; apex acute; cardinal teeth prominent; lateral teeth none. (Plate IV, fig. 7.)

Tellina papyria, Con.; Foss. Shells of Tert. Form., p. 41.

Claiborne, Alabama. Very rare.

Tellina alta. Suborbicular, inequivalved, inequilateral, with lamelliform concentric lines, not closely arranged, and minute closely arranged radiating wrinkles; posterior side obtusely fold-

ed, the inferior margin truncated obliquely inwards; lateral teeth distinct; the posterior one very short, pyramidal, remote. (Plate IV, fig. 10.)

T. alta, Con.; Foss. Shells of Tert. Form., p. 41.

Claiborne, Alabama. Very rare.

In this species one valve is considerably more convex than the other, and the anterior muscular impression is rather deeply impressed, and bounded on the inner side by a broad rib-like elevation, which extends to the apex.

TELLINA PLANA. Scaleniform, very much compressed, very inequilateral, smooth and polished; substance of shell very thin; beaks very small and pointed; lateral teeth lamellar. (Plate IV, fig. 6.)

Egeria plana, Lea; Cont. to Geol., p. 54, plate i, fig. 25.

Claiborne, Alabama.

TELLINA RAVENELI. Suboval, inequilateral, moderately thick, with very fine regular concentric lines and with brown bands; anterior margin obliquely truncated above; posterior side obtusely folded; beaks a little prominent; lateral teeth large and prominent, compressed; area above the anterior lateral tooth dilated. (Plate V, fig. 1.)

Claiborne, Alabama.

Of this species I have only an imperfect right valve. Its most remarkable character is the somewhat angulated form of the anterior dorsal margin. It is dedicated to Dr. Ravenel of Charleston, S. C.

TELLINA SCANDULA. Ovate, much compressed; anterior margin rounded; ligament margin very oblique, slightly curved; fold near the posterior margin, angulated, subcarinated; basal margin rounded; beaks scarcely prominent above the hinge line, submedial, nearest the anterior end. (Plate IV, fig. 8.)

T. scandula, Con.; Jour. Acad. Nat. Sciences, vol. vii, p 132.

Claiborne, Alabama.

I found only one valve, a right one, and this is imperfect; the cardinal plate is broad and thick, with two diverging compressed teeth, and no lateral teeth. The substance of the shell is moderately thick.

CORBIS.

The genus Corbis of Cuvier originated in the Eocene period. Two species occur in the Paris Eocene, one of which is also

found at Claiborne, Alabama, but is so rare that I have seen but one valve. Lamarck describes but one recent species, an inhabitant of the Indian Ocean.

Corbis undata. Ovate, ventricose, with about twelve concentric ribs or undulations, very strongly prominent, acute, remote on the umbo, lamelliform towards the apex, but thick, less prominent and approximate towards the middle of the valve; on the inferior half of the valve are irregular concentric compressed lines; disk with radiating lines, obsolete on the middle of the inferior half of the valve, profound on the sides, crenulated on the anterior side; posterior side with distant prominent lamellæ, five or six in number; beaks medial; inner margin crenulated. (Plate IV, fig. 11.)

Corbis undata, Con.; Foss. Shells of Tert. Form., p. 40.

C. distans, Con.; ib. (Immature shell.)

Claiborne, Alabama.

A beautiful and very rare species. Immature shells have acute prominent remote ribs, covering the whole disk, and are comparatively less ventricose than mature specimens.

Corbis lamellosa. Elliptical, compressed, with distant elevated lamelliform ribs, and fine radiating striæ; ribs towards the base less remote and more robust; on the posterior slope the laminæ are more profoundly elevated. (Plate IV, fig. 16.)

Corbis lamellosa, Lam.; An. sans Vert. Chemnitz; Conch., vol. vi, tab. xiii, figs. 137, 138. Encyc. Meth. plate cclxxxvi, figs. 2, a, b, c. Desh.; Coq. Foss., t. i, plate xiv, figs. 1, 2, 3.

Claiborne, Alabama.

The extreme scarcity of this shell at Claiborne is remarkable, as it is very abundant in the Paris Eocene. It varies little from the Paris specimens, the principal difference being in the thicker and more approximate ribs towards the base.

Lucina.

The genus Lucina of Bruguière is very numerous in fossil and recent species. Deshayes enumerates as many as fifty nine tertiary species, thirty one of which are in the Paris Eocene. The number, however, will be somewhat restricted by separating the group termed Loripes by Poli. In Europe the genus is supposed to occur as low as the Great Oolite. The Eocene of this country contains seven known species; the Miocene twelve, of which

seven are living inhabitants of the coasts of the Union. Of these, two live as far north as Massachusetts, L. radula, (L. contracta, Say,) and L. divaricata, both of which also inhabit the European coasts of the Atlantic. The others inhabit the coasts of Carolina and Florida, and one of them, L. crenulata, occurs at Cape Henry, Virginia. I obtained six species about Tampa Bay. One of these, L. Floridana, is very nearly allied to the Miocene L. anodonta, Say. The genus is more largely represented in our Miocene beds, by recent species, than any other group of shells.

LUCINA ALVEATA. Ovate, ventricose, with prominent concentric lines, and remote profound concentric sulci; summits very elevated, medial; posterior margin truncated, direct; posterior side with an indistinct submarginal fold; cardinal and lateral teeth distinct; inner margin crenulated. (Plate IV, fig. 12.)

Lucina alveata, Con.; Foss. Shells of Tert. Form., p. 40, Nov. 1, 1833.

L. lunata, Lea; Cont. to Geol., plate i, fig. 32, Dec. 1833.

Claiborne, Alabama.

A variable species; some specimens have a distinct fold, others none; the sulci vary much in number, generally from two to five. Occasionally traces of radiating lines are visible under a glass, which are most distinct on the margins of the sutures.

LUCINA CARINIFERA. Suborbicular, profoundly ventricose, with concentric acute striæ; anterior side with a slightly impressed fold, and the superior margin with a short rostrum or prominent angle; posterior side with a narrow, profoundly impressed fold, emarginate at base; summits very prominent, submedial; beaks incurved; cardinal and lateral teeth distinct; inner margin crenulated. (Plate IV, fig. 15.)

Lucina carinifera, Con.; Foss. Shells of Tert. Form., p. 40, Nov. 1, 1833.

L. cornuta, Lea; Cont. to Geol., plate i, fig. 29, Dec. 1833.

Claiborne, Alabama. Rare.

LUCINA POMILIA. Suborbicular, equilateral, convex or slightly ventricose, with remote profound concentric sulci, and obsolete striæ; an obscure trace of radiating lines; an impressed fold near either end margin, truncated, or somewhat emarginate at base; beaks prominent and pointed; cardinal and lateral teeth distinct; inner margin minutely crenulated. (Plate IV, fig. 17.)

Lucina pomilia, Con.; Foss. Shells of Tert. Form., p. 40, Nov. 1, 1833.

L. impressa, Lea; Cont. to Geol., plate i, fig. 30, Dec. 1833.

Its varieties approach so near to those of the preceding species, that it may not be really distinct. It is usually less ventricose and less elevated and more distinctly folded. In some specimens the posterior fold is profound.

LUCINA MODESTA. Orbicular, ventricose, thin, with minute approximate concentric lines; posterior side with an impressed submarginal fold; posterior margin truncated, direct; ligament margin straight and oblique; beaks prominent, medial. (Plate IV, fig. 13.)

Claiborne, Alabama. Rare.

LUCINA SUBVEXA. Suborbicular, profoundly ventricose, with fine concentric and minute obscure radiating lines; posterior side with a fold consisting of two furrows, the submarginal one obscure; radiating lines minute and obscure; anterior margin elevated and angulated at the extremity of the hinge line; anterior side with an obsolete fold; posterior margin truncated, direct; umbo ventricose; beaks medial; hinge narrow, edentulous; within profoundly punctate. (Plate IV, fig. 14.)

Lucina subvexa, Con.; Foss. Shells of Tert. Form., p. 40.

Claiborne, Alabama.

A rare species. I have but one valve, which is thin about the basal margin, thicker above, with a rough unequal radiato-punctate interior; the lunule small and impressed, and the hinge plate narrow and without teeth.

Explanation of the Plates.

PLATE III.

Fig. 1. Crassatella alta.
2. C. protexta.
3. C. alæformis.
4. Outlines of immature shell of C. protexta.
5. C. rhomboidea.

PLATE IV.

Fig. 1. Crassatella palmula.
2. Amphidesma linosa.
3. Corbula oniscus.
4. C. nasuta.
5. Amphidesma tellinula.
6. Tellina plana.
7. T. papyria.
8. T. scandula.
9. T. Sillimani.
10. T. alta.
11. Corbis undata.
12. Lucina alveata.
13. L. modesta.
14. L. subvexa.
15. L. carinifera.
16. Corbis lamellosa.
17. Lucina pomilia.

PLATE V.

Fig. 1. Tellina Raveneli.

Catalogue of recent shells, which occur also fossil in the Miocene deposits in the United States.

Since I enumerated the proportion of recent species in Miocene deposits in the Proceedings of the Academy of Natural Sciences, I have obtained others and identified some more in my cabinet, and every new research in those beds must bring others to light, varying in some slight degree the proportion of living and extinct species.

Bivalves.

1. *Artemis acetabulum*, Con. Florida.
2. *A. elegans*, Con. Florida.
3. *Astarte lunulata*, Con. Charleston.
4. *Arca improcera*, Con. Southern coast.
5. *Anomia ephippium*, Lin.
6. *Amphidesma equale*, Say. Southern coast.
7. *Cardita tridentata*, Say. Southern coast.
8. *C. granulata*, Say. Southern coast.
9. *Chama arcinella*, Lam. Southern coast.
10. *Cumingia tellinoides*, Con. Southern coast, Massachusetts.
11. *Cultellus caribæus.* Southern coast, Massachusetts, New Jersey.
12. *Cytherea elevata*, Con. Gulf of Mexico.
13. *C. Sayana*, Con. Rhode Island, Massachusetts, New Jersey.
14. *Lucina crenulata*, Con. Cape Henry, Virginia.
15. *L. divaricata*, Lam. Atlantic coast.
16. *L. jamaicensis*, Lam. West Indies.
17. *L. trisulcata*, Con. Florida.
18. *L. radula*, Lam. Rhode Island, Massachusetts.
19. *L. squamosa*, Lam. Southern coast.
20. *Mactra lateralis*, Say. Atlantic coast.
21. *Nucula acuta*, Con. Florida.
22. *N. proxima*, Say. Atlantic coast.
23. *N. limatula*, Say. Massachusetts.
24. *N. acuta*, Con. Gulf of Mexico.
25. *Pecten concentricus*, Say. Atlantic coast.
26. *Tellina lusoria*, Say. Southern coast.
27. *Venus cancellata*, Lam. Southern coast.
28. *V. mercenaria*, Lin. Atlantic coast.
29. *V. metastriata.* Florida.

Univalves.

1. *Cerithium clavulus*, H. C. Lea. Tampa Bay.
2. *C. dislocatum*, Say. Southern coast.
3. *Dentalium coarctatum*, Lam. Gulf of Mexico; Europe.
4. *D. dentale*, Lin. European coast.
5. *Dispotæa rugosa*, (*Calyptræa*,) Brod. South America.
6. *D. corrugata*, (*Calyptræa*,) Brod.; *D. ramosa*, Con. South America.
7. *Crepidula unguiformis*. Atlantic coast.
8. *C. fornicata?* Lam. Atlantic coast.
9. *C. convexa?* Say. Atlantic coast.
10. *Fulgur carica?* Southern coast.
11. *F. canaliculatus*. Atlantic coast.
12. *Natica heros*, Say. Atlantic coast.
13. *N. duplicata*, Say. Atlantic coast.
14. *N. canrena*, Lam. Florida.
15. *Nassa trivittata*, Say. Atlantic coast.
16. *N. obsoleta*, Say. Atlantic coast.
17. *N. lunata*, Say. Atlantic coast.
18. *Oliva litterata*, Lam. Florida.
19. *O. zonalis*, Lam. Florida.

Multivalve.

Balanus ovularis. Atlantic coast.

This makes forty nine recent, out of three hundred and forty four species in my cabinet. The per-centage of recent forms will not vary, I presume, through future discoveries to any great amount.

ART. IX.—*Notices of Fresh Water Shells, &c., of Rockbridge County, Virginia;* by T. A. CONRAD.

LAST summer, while on a visit to my friend, Constant W. Newkirk, Esq., in Rockbridge County, Virginia, I paid some attention to the Naiades and univalves of the vicinity. The river here is called the "Calf Pasture," and is a small stream flowing through a mountain gorge. It is a branch of North river, which latter unites with James river near the Blue Mountain chain. It may not be uninteresting to conchologists to learn that

the second species of Unio known to have spines is abundant in these rivers. I collected a great variety of them, and observed some peculiarities that may not be unworthy of notice. I was indebted to muskrats for all the specimens having spines, except some very young shells which I took alive; and thirty or forty occurred in one spot, in company with the very young of U. lanceolatus. No where else, after a diligent search, could I find the young of either species. On the muddy shore of the river where muskrats resort, especially about the still water of the dams, I procured many specimens of Unio collinus, with spines, which I found to vary in the number and position of these spines; some would have a rather long spine on one valve only, others a spine on each valve; others two short ones on the umbo, ranged in the direction of the shell's length; others with three spines, and some with two ranged in a line from beak to base. One specimen has a spine just below the umbo, and near the base are two thick ones in a line with the shell's length. In very rocky places where the water is rapid I found some living specimens of this species, all destitute of spines, which indeed is the condition of a great majority of the *collinus*. It is worthy of observation that this spinous character prevails most among the specimens in still water where there is a muddy bottom, and least of all where the water is most rapid. On the rocks live vast numbers of Anculosa dilatata, a very variable univalve, and this, with a few specimens of Melania virginica, Ancylus rivularis, Planorbis parvus and Paludina decisa, were the only univalves I noticed. The Unio lanceolatus is abundant, and may be found alive among the rocks and stones. Great numbers always occur, with the animals eaten out, about the muskrat haunts and holes in the banks. Unio subplanus, *Con.*, is not uncommon in similar situations, and U. constrictus, *Con.*, is still more abundant. The latter species and U. purpureus of Say, are the two species most commonly obtained alive.

It is curious to observe the partiality of the muskrat for particular haunts, as is made evident by heaps of shells, the relics of their nightly repasts. A particular rock near shore, surrounded by water, will be seen covered with shells, and on one side of the rock a deep stratum of them in the mud, while other rocks near, apparently equally well fitted for the festive board, are never furnished with a single shell. I have repeatedly visited one of their favorite rocks in a morning, and collected fine specimens which

had been fished up and the animal eaten over night. But although Unio collinus was common among them, and the water was shallow, I was unable to find the living specimens whose haunts seem to be so well known to the Naiad-loving quadruped.

Between the different mountain spurs in this wild region, there are beautiful valleys with level and fertile land. The mountains are quite steep and composed of non-fossiliferous rocks of the carboniferous system, but coal does not occur. Iron ore is excellent and abundant, and within a short distance of Mr. Newkirk's furnace. The climate here is about the same as that of the latitude of Philadelphia, the elevation of the land being equivalent to the difference of latitude. But in these wooded and mountain regions the sudden fall of temperature at night, is often very great, particularly after rain, and therefore ill suited to an invalid's constitution.

The shells of Calf Pasture river are comprised in the following list:—

Bivalves.

Unio collinus, *Con.*
U. purpureus, *Say.*
U. constrictus, *Con.*
U. subplanus, *Con.*
U. lanceolatus, *Lea.*
Alasmodon undulata *Say.*
A. marginata, *Say.*
Anodon cataracta, *Say.*
A. marginata? *Say.*

Univalves.

Planorbis parvus, *Say.*
Ancylus rivularis, *Say.*
Paludina decisa, *Say.*
Anculosa dilatata, *Con.*
Melania virginica, *Say.*

ART. X.—*On the detection of Spirally dotted, or Scalariform Ducts, and other vegetable tissues in Anthracite Coal;* by Prof. J. W. BAILEY, of the U. S. Military Academy.

ON perusing in this Journal (p. 124, present volume) an account of the results obtained by Schultz and Ehrenberg in the microscopic examination of coal decarbonized by means of nitric acid and heat, I felt a desire to repeat the experiments and obtain if possible some of those "white splinters" which they found "composed of aggregated siliceous cells arranged in regular succession, of the structure of the prosenchymatous cells of wood." But just as I was about to commence the repetition of these experiments, it occurred to me that I might find the decarbonization in every stage of progress, among the masses of some par-

tially burned Pennsylvania anthracite, with which a grate in my room was filled, in which the fire had been allowed to smother itself in its own ashes.

I was not disappointed, for I found that many of the masses of partly burned coal readily separated into numerous laminæ, on almost all of which, when magnified, vegetable structure could be detected, and on many of which the tissues were preserved in a state of unhoped for perfection.

Several varieties of structure presented themselves, the most interesting of which however were well characterized *dotted* or *scalariform ducts*, in a most perfect state of preservation, and forming somewhat rectangular plates, which are often several inches long, and one or more broad. These specimens, whose beauty and perfection can scarcely be exaggerated, present all the original markings of the vessels with a distinctness which leaves scarcely any thing to be wished for. They may be examined either as opaque objects, in which case the silica appears in relief against the black coal, and shows the form and markings of the tubes very finely; or still more satisfactory results may be obtained by melting some inspissated Canada balsam upon a plate of glass, and while melted touching it to a surface of the coal upon which the ducts had been previously found to exist. When the balsam has hardened, the coal may be pulled off, and it will be found that it leaves fixed upon the balsam a thin layer of silica, containing perfectly preserved dotted vessels, which when viewed as transparent objects, are nearly as distinct in their markings as if freshly obtained from a recent plant. (See the figures, p. 410.) I have a large number of specimens, and hope to find means to place them in the hands of all interested in such researches.

Besides the dotted vessels, which appear to be something very different from the "prosenchymatous cells of wood" obtained by Schultz, other tissues occurred, among which were small masses of woody fibre with no definite markings, also layers appearing to be composed of the cells of the epidermis of the stem of some plant, and, rarely, traces of tissue presenting what appear to be the remains of Stomatæ. All these require a more careful study before any very definite conclusion can be drawn from them.

A few inferences appear however to be fairly deducible from the examination already made, viz.

1. It appears that almost every layer of the coal is composed of vegetable matter, which still retains very distinct remains of

the original organic structure, and which consequently could never have been reduced to a homogeneous pulp.

2. The plants from which the coal was *chiefly* formed do not appear to have been allied either to the Coniferæ, or the ordinary Dicotyledonous or Monocotyledonous plants. Their nearest analogues must probably be sought among the Acotyledons, among which Ferns and Lycopodiaceæ present similar vascular bundles, composed chiefly of bothrenchymatous tissue.*

3. Even allowing for the effects of compression, it does not appear probable that the petioles of even the tree ferns could have furnished such large flattened plates of scalariform ducts unmixed with other tissues as are found in the coal, and which *very rarely* have any traces of fronds of ferns preserved in the same mass.

4. It is possible that the ducts in question may really have belonged to the Stigmaria itself. Lindley and Hutton, from the examination of a magnified section of a silicified Stigmaria, pronounce it to be a plant whose woody portions were entirely composed of *spiral vessels;* but their figure of these vessels, however interesting, leaves some room to suppose that *spirally dotted ducts* partly obscured by petrifaction might have been mistaken for true spiral vessels. (See Fossil Flora of Great Britain, vol. iii, plate 166.) This view is confirmed by Unger, who attributes dotted ducts alike to the Stigmariæ and the woody layers of Lepidodendreæ and Sigillariæ. (Endl. Gen. Plant. sup. 2, pp. 5, 6.)

5. Vascular bundles must certainly have extended from the scars found on the Stigmaria and Sigillaria to the deciduous appendages, (see Foss. Flora, vol. i, plates 31, 32, and 33,) whether these latter were leaves or radical fibres, and the partial decay of masses composed of numerous layers of such appendages, would account for most of the appearances observed in the coal.

6. The proofs afforded by these examinations, that the coal is composed of layers, of great tenuity, of vegetable matters scattered in a confused manner, and that no trunks of trees or any considerable portion of their branches had any thing to do with its formation, are in exact accordance with the inferences drawn by Prof. H. D. Rogers, from an examination of the mechanical structure of unburned coal.†

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* Since the above was written, I have observed that Ad. Brongniart, in a recent number of the Comptes Rendus, maintains that Stigmaria, Sigillaria and Lepidodendron, as well as Noeggerathia, are all allied to the Gymnospermous dicotyledons.

† See Transactions of the Association of American Geologists, p. 448.

7. As anthracite is only bituminous coal which has lost its volatile matter, the results obtained from it apply to all varieties of the true coal of the Carboniferous epoch. The presence of bitumen, however, and the consequent swelling and partial fusion of the ordinary coal, render it difficult to obtain from it the tissues in the perfection in which they may be found in anthracite.

Fig. 1.

Fig. 2.

Fig. 3.

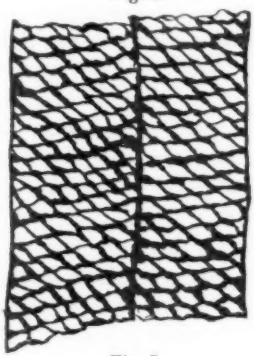
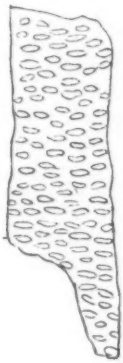


Fig. 5.

Fig. 4.



Explanation of the Figures.

Fig. 1, shows the appearance to the naked eye of a mass of partly burned anthracite, on which the vascular tissue is found. The black portion is the unconsumed coal. The white portions represent the silica left after oxidation of the carbon.

Fig. 2, shows the manner in which the vessels occur in successive superimposed layers. It also gives an idea of the general appearance of the tissue when moderately magnified; the black lines being the unburned coal, the white spaces being spots of silica.

Fig. 3, is a sketch made by the camera-lucida, showing the appearance, as an *opaque* object, of a small portion of two ducts from anthracite, much magnified. The white irregular spaces are patches of silica; all the black lines represent unburned coal.

Fig. 4, is a sketch made by the camera-lucida, showing the appearance, as a *transparent* object, of a fragment of a single duct from anthracite, much magnified. The ovoidal spaces are thickened portions of the siliceous plate, and apparently correspond to the pits in the walls of the original tissues.

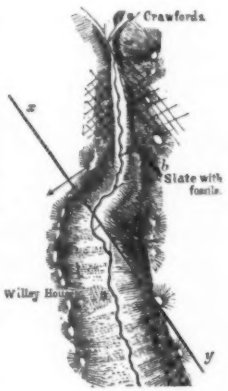
Fig. 5, shows $\frac{1}{100}$ths of a millimetre, drawn by means of a camera-lucida from a micrometer equally magnified with the two last figures.

ART. XI.—*On the Geological Age of the White Mountains;* by Prof. HENRY D. ROGERS and Prof. WILLIAM B. ROGERS.

THE White Mountains, the most elevated of the mountain masses of the Atlantic side of North America, have been hitherto regarded as consisting exclusively of the granitic and gneissoid rocks under their several modifications, and as having originated in the so-called primary periods of geological time. This common notion of their great antiquity is to be ascribed to the highly crystalline texture of many of their more conspicuous rocky masses, which, until closely scrutinized, do certainly bear a near resemblance to the typical forms of the most ancient gneiss, mica slate and granite. But it involves we conceive two errors, first, that of assigning to all the strata of the gneissoid class, merely in virtue of their crystalline aspect, a date remoter than that of the protozoic or earliest fossiliferous deposits; and secondly, the error of supposing that the strata of these mountains contain no organic remains. So long as their fossiliferous character was undiscovered, the metamorphic condition of these rocks might naturally enough deceive the observer and lead him to false inferences in relation to their age.

Having in the month of July last, enjoyed the opportunity of studying with some care the structure and composition of that part of the chain which is exposed to view in the picturesque and deep defile of the Saco, we had the good fortune to detect in the vicinity of the Notch, the fossiliferous character of a portion of the strata, and to see through the metamorphic disguises in which intense igneous action has obscured these originally sedimentary palæozoic masses. We succeeded in determining some of the organic remains sufficiently to identify thereby some of the formations, much altered as they are from the purely sedimentary aspect, and from these data we have attempted to deduce some inferences respecting the *limit of antiquity* of these mountains, and the date of their elevation. By detecting in many of the pseudo-granitic rocks a genuine sedimentary stratification, we were able to follow in sundry places the true direction of the almost obliterated bedding, and to discover the course of the anticlinal axes. These once clearly recognized, led us finally to conclusions which have much interested us in regard to the

structure of the whole chain and the nature of the forces of elevation. In the present short paper we propose to submit a concise abstract of these observations, and the results to which they have brought us.



By inspecting the accompanying little map, the reader will notice that the general direction of the Gorge of the Saco, neglecting the local windings in its course, is nearly from north to south. In one place, about half way between Crawford's and the Willey house, the contracted valley as we trace it south bends abruptly to the westward, and in the distance of perhaps a furlong sweeps back again into its former southerly direction, making a double or sigmoid curve. This feature is especially favorable to the exhibition of the range and dip of the rocks, which are here exposed endwise in the transverse section. In the mountain on the north and west of the Gorge, the end of which is full in front of the traveller as he ascends the valley from the Willey house, the stratified structure of the rocks throughout this gigantic ridge, is plainly to be seen in the differently colored perpendicular belts which outcrop edgewise along its naked and nearly mural face.

At the Notch (represented in the sketch at *a*) the rocks on both sides of the narrow chasm are traversed by two sets of nearly vertical planes or joints, the one running nearly N. E. and S. W., the other nearly N. W. and S. E. Though in this place the stratification is but obscurely indicated, we succeeded in making out the planes of bedding; and in some cases with such satisfactory clearness as to prove the true strike of the beds to be N. E. and S. W., and the dip to be for the most part vertical, but with some local arching. Observations made both at this locality and elsewhere, induced us to regard the rocks of the Gorge generally as a group of highly metamorphic sandstones and slates, traversed by enormous beds and veins of syenitic granite, by the heating agency of which they had for the most part been rendered semi-crystalline, and in some cases had even been transformed into apparent gneiss and granite. At certain points in these altered strata, the original sedimentary structure is still dis-

tinctly retained; and at one locality we were so successful as to discover well characterized impressions and fragments of fossils, from which we have been able, safely as we think, to approximate to the geological age of the strata, as well as to the epoch of the earliest movement of elevation.

At the curve in the valley, where the anticlinal axis $x\,y$ crosses the Gorge obliquely, entering the end of the ridge already alluded to, and from that point down to the Willey house, the rocky fragments dislodged from the naked and steep slopes on either side, consist chiefly of a finely laminated hard sandy slate of a bluish color, and a coarse very compact rock of similar composition; and mingled with these are occasionally found masses of the same composition, but wearing a more altered aspect, some of them containing crystalline spots and white amygdaloidal kernels, the obvious indications of an advanced stage of igneous metamorphosis. These fragments are extremely instructive; for they exhibit nearly all the later stages of alteration, from the ordinary sedimentary texture to the diffusedly crystalline one. In some cases we see the planes or lines of sedimentary deposition coexisting with a general but not fully perfected crystallization, in which however may be distinctly discovered genuine *feldspar*, *augite* and *mica*. Such specimens are to be viewed as an incipient hornblendic gneiss, in which through the sedimentary granular structure, typical of the secondary strata, may be seen everywhere and intimately dispersed, the crystallized definite mineral aggregates equally typical of the so-called primary rocks. Many of these specimens seen facewise, would pass for genuine ancient gneiss; but looked at edgewise, they betray equally unequivocal marks of their sandstone nature and origin. Among the more argillaceous altered rocks, are some which have evidently once been sandy shales, but which now consist of a purplish gray semi-crystalline base, imbedding several obscurely developed minerals. These rocks likewise contain serpentine, talc, and other silico-magnesian species, as well as some clearly insulated grains of crystalline quartz.

About one third of a mile below the northern entrance of the Notch, on the west side of the Gorge and therefore not far from the extremely wild and picturesque cascade called the Flume, there occurs especially in the craggy summit of the mountain, a

thick-bedded white semi-crystalline altered sandstone, which is intersected by injections of feldspathic granite, and is itself in many parts concreted into a near approximation to a binary granite composed of distinctly developed quartz and white feldspar, with a few sparsely scattered specks of mica. In its weathered surfaces this rock wears a close resemblance to some fine grained quartzo-feldspathic granites, but upon inspecting a fresh fracture with a magnifier, we instantly perceive many rounded grains of quartzose sand: we perceive moreover much of the feldspar to be only imperfectly formed, as if congealed when *in transitu*, though the mica has more nearly reached the standard condition which it has in granite. In some of the coarser varieties of this white rock, small distinctly rounded pebbles of quartz are to be seen, giving unequivocal evidence, even to the naked eye, of its being an altered sandstone. Upon inspecting many varieties of this rock, we felt no hesitation in deciding it to have been a coarse silico-argillaceous white sandstone, now almost granitized by extensive metamorphic action. The slope of the steep mountain side is in many places strewed even to its base, with long trains of the angular blocks of this seeming granite fallen from the high crowning cliffs above. Seen in places near the summit of the mountain, the rock presents two or more systems of extensive and very regular joints or planes of cleavage, by which the whole mass is cut into cubical and trapezoidal blocks. This jointed condition, itself so significant of an extensive internal structural change, is a principal cause of the magnitude of the piles of fragments which clothe the slopes of the mountain. It is beheld even more conspicuously in the shattered crests which bound the valley above and below the Willey house, where an almost continuous thick sheet of coarse angular *debris* conceals the stratification except in the craggy precipices near the summits. Those sublimely terrific and desolating *slides* which have occurred here at different times, are therefore primarily attributable to this jointed structure. This has permitted the elements to dislodge the fragments and heap an unusually abundant and heavy *talus* high upon the slopes of the steep hills, where its unstable equilibrium, weakened by saturation from copious rains, has caused great bodies of the rubbish to give way and rush down with destructive impetuosity into and across the bed of the narrow valley beneath.

Generalizing the position and dip of these clearly mechanical but altered strata, on both sides of the gorge of the Saco, we think that there are ample data for inferring the existence of a great anticlinal fold or axis, crossing the valley in a direction nearly N. W. and S. E., as represented by the line *x y*. This axis is plainly indicated on each side of the Gorge by a deep depression in the summit line of the mountain, especially in the crest which overlooks the valley on the western side. At this latter place the situation and bend of the axis line is easily discernible, even from the valley below, in consequence of the contrast of certain dark-colored argillaceous strata, in color and bedding, to the other rocks.

In the flank of the mountain, capped by the highly altered white granitized sandstone already mentioned, we discover on the west side of the Gorge, about one third of a mile below the Notch and within one hundred feet of the road, a thick bed of a light brownish altered shale, imbedded with a nearly vertical dip between strata of the metamorphic sandstone before referred to, as so nearly granitic in its aspect. This shale is replete with fossils of recognizable genera and species, but in the state of casts and mere impressions. The removal of the substance of the fossils from the rock, has probably been the result of filtration and solution, completed previously to that intense heating of the strata by which the more fusible masses were so extensively baked and metamorphosed.

Among the fossils are what *appear* to be *fish-scales*, also a small *Agnostis*, the specimens of which though only impressions, have a strong likeness to the Agnostis latus of our *Levant series*, (Clinton group of New York.) We recognize likewise a *Cytherina*, like C. alta, of the same formations. There are also innumerable minute objects, which are probably the organs of some small crustacean. In addition to these, we recognize among the shells, the Atrypa ferruginea, (nobis.) so characteristic of the *Levant series* in Pennsylvania and Virginia, and a small tumid shell, probably also an Atrypa, identical, we think, with another *Levant* species. Also a *Lingula* like *L. Clintoni*. Some specimens abound in very minute globular bodies, somewhat like the granules of green sand in color, but which may possibly be organic. These and other seemingly organic forms we hope soon to subject to a more thorough examination than we have yet been able to give them.

Though the number of species possessing a sufficiently definite form is very limited, we think we may safely refer them to the *Levant series* of our nomenclature, (embracing the Clinton group of New York.) Some of the forms however bear an analogy to certain species which abound in the higher part of the *Matinal series*, in the *Matinal newer shales*, (Hudson river group,) and we desire therefore to be understood as venturing our opinion of their belonging to the Levant formations, with considerable hesitation. We should mention however that besides the above affinities of the fossils, there are several features about the rock, especially the great abundance of Agnostis and other minute organic forms, which induce us to lean to the conclusion that it is a member of the great Levant series.

This stratum, so remarkably fossiliferous, is only a few yards in width where it is exposed at the locality we have designated, and it there lies with a nearly vertical dip, between masses of highly altered sandstone, possessing, until carefully inspected, a close resemblance to granite. The white feldspathic or granitized sandstone, already described as crowning the top of the hill, belongs probably to one of these including masses; but from the perpendicularity of the dip it is obviously impossible to infer which was originally the superior formation. Near the summit of the ridge, however, the sandstone seems to overlie the shale; but an inversion of the dip here might very naturally exist, and it is necessary therefore to appeal to some other evidence than that of position merely to determine the stratigraphical order of these rocks. As the altered white sandstone in the portions examined, is apparently destitute of organic remains, we have no feature to guide us but its composition and aspect. These are well marked and strongly indicate its identity with the *Levant white sandstone*, (or Shawangunk grit.) To no other formation in the whole Apalachian series, except perhaps the *primal sandstone*, (Potsdam sandstone,) does it bear any near resemblance, and its affinity even to the primal sandstone is rather remote. The shales belonging to the primal rocks contain moreover scarcely any fossils and certainly none of the species here enumerated, and since there is no visible hiatus in the strata indicated by an unconforming dip, this argument may be held to be conclusive. We are therefore disposed to regard the two formations, the white sandstone and the fossiliferous shale, as the equivalents respec-

tively of the *Levant white sandstone* and one of the higher *Levant shales* near the horizon of the fossiliferous iron ore. Upon this view some of the intermediate shales are absent, and when we advert to the distance between the White Mountains and the nearest outcrop of the *Levant series* in New York, this ought not to surprise us. Upon the less probable conjecture that the fossiliferous bed is a portion of the *Matinal shales*, no assumption of a deficiency in the series is required, for the *Levant white sandstone* comes naturally next in the ascending order. The general conclusions to which we are brought by this unexpected discovery of a fossiliferous formation, related evidently to one of the earlier Apalachian periods, are not however in the slightest degree affected by this trivial amount of uncertainty respecting the age of either bed. We proceed therefore to state the inferences deducible from the foregoing facts.

One of the most interesting conclusions to be drawn from the evidence afforded by the above described fossiliferous strata, relates to the geological age of the chain of the White Mountains. These strata present convincing proofs that the region, now occupied by this mountain chain, was overspread by the waters of the ancient Apalachian ocean at an era as late in the Palæozoic ages, as the Matinal, or more probably the Levant periods. Placed as the district is, immediately between the nearly contemporaneous formations of the states of Maine and New Brunswick on the one hand, and Vermont and New York on the other, it fills up an interval in the area of the Apalachian rocks, which hitherto seemed vacant, and suggests strongly that the waters of the *Matinal* or *Levant* eras, extended continuously across at least all northern New England. As it is known that the Apalachian strata abound as far to the N. E. as Nova Scotia, and perhaps Newfoundland, and spread to a great distance north and northwestward in the continent, the prodigious magnitude of the Apalachian sea, at least in its earlier periods, is made apparent. But while these fossiliferous beds of the White Mountains make it probable that the continuity of this sea was unbroken by any land in the position of New Hampshire before the Levant period, they indicate as plainly that some land did emerge after this period had commenced. How long subsequent to the deposition of the earlier Levant strata that portion of the bed of the ocean was uplifted into land, it is not practicable very positively to ascer-

tain, until we are certain of the latest age in which any of the fossiliferous rocks of the White Mountains were produced. That the elevation was before the *Carboniferous period*, which witnessed the final draining of the Apalachian sea, seems manifest enough from two considerations.

It is almost certain, in the first place, that none of the Apalachian strata of the middle or latter ages were deposited within this region; for no traces of the coal rocks nor of the fossiliferous *Post-medial shales*, (Marcellus shales, &c.,) nor any of the red shales referable either to the later *Levant* or the *Ponent* (Catskill group) *periods* have yet been met with: and since these newer palæozoic formations abound both to the S. W. and N. E. we must infer that their absence in this locality is due to a lifting out from the bed of the sea previous to their deposition. Had they been deposited within this area, some remnants of these strata would almost certainly have been preserved from denudation in the close folds or synclinal bends of this contorted district. In the second place, there is abundant evidence in the region of the Hudson valley, where the Levant rocks rest almost horizontally on the upturned edges of the Matinal, that the bed of the Apalachian waters underwent a local disturbance at the close of the Matinal period, and it is equally obvious that the direction of this disturbance, as seen in the course of the axes of elevation and depression, was different from that of the subsequent movement by which all the deposits *at the end* of the Apalachian ages were contorted and upraised. So in like manner we may perceive, in the structure of the White Mountains, the proofs of two distinct intersecting systems of dip, the components of two separate sets of axes or contortions of the crust, indicating two different epochs of elevation. One of these, and apparently the latest, is a N. N. E. and S. S. W. set of anticlinal and synclinal folds; and is therefore probably a part of the general movement which lifted the whole Apalachian or Alleghany chain, and drained away the palæozoic waters; but whether the other accords as nearly in direction and date with the earlier system of the Hudson valley, the epoch of which was either at the close of the Matinal or early in the Levant times, is an important and interesting question which only future research can answer. The most natural inference from all the facts would seem to be, that in the somewhat disturbed period last referred to, when, as geologists are already aware, all

the more ancient Apalachian rocks, from the earliest to perhaps the Levant sandstones, suffered a contortion and general uplift in the region which is now the northern part of the Hudson valley, the same disturbance and elevation of the earth's crust extended to the district which is now the White Mountain chain. If we conceive indeed the whole of the wide tract of undulating and in some places mountainous surface, from the upper Hudson and Lake Ontario, eastward to Maine inclusive, and possibly a large territory north of the St. Lawrence, to have emerged from the waters into permanent land, during the close of the Matinal period and the first ages of the Levant, while the still wider spaces to the S. W. and N. E. remained undisturbed, for the reception of later strata, we shall be able to interpret many important facts in the geological structure not only of this ancient district but in that of the neighboring regions.

The hypothesis which supposes that the bed of the Apalachian ocean was violently and extensively agitated by a succession of earthquake movements, at the end of the Matinal and early in the Levant periods, resulting in the conversion of all northern New York and New England, and probably the whole southeastern border of that sea into permanent dry land, supplies us in the first place with an explanation of the unconformable superposition of the Levant upon the Matinal rocks, discovered by one of us in 1837 near the city of Hudson, and visible at a number of other points E. and N. E. of the Catskills. It furnishes moreover a cause for the extremely wide diffusion, and the coarse conglomeritic composition of the early Levant sandstones, amid the pebbles and sand-grains of which, are many fragments obviously derived from the uplifted and broken Matinal and Primal strata. It provides furthermore a physical reason for the marked transition observable in the species, when we ascend from the organic remains of the Matinal to those of the Levant formations. An era of paroxysmal action would be naturally the period of a modification in the conditions and forms of life, for extensive and permanent changes would arise in the bed of the sea, the waters would grow shallow in many places, would deepen in others, their temperature and their currents would alter, and even the proportions of the elements held in chemical solution, which are the very pabulum of the aquatic races, would sustain some change. But perhaps the most interesting application of the hypothesis here referred to, is the explanation

it affords of the excessively crystalline or metamorphic condition of the Apalachian deposits in the district supposed to have undergone this ancient elevation. Upon this supposition these districts, embracing nearly all New England and the Atlantic slope of the Middle and Southern states, were the areas of chief movement, while the other portions of the Apalachian sea were but slightly affected. Here therefore the crust underwent the maximum degree of dislocation and of heating, and the newly precipitated surface sediments were rent, brought into contact with the intensely heated veins and dykes of internal molten matter, and baked and probably partially crystallized, while those of the remoter and still submersed tracts were but slightly acted on. As these districts, the southeastern and northeastern parts of the Apalachian basin, were the first to be invaded by igneous action, so they continued, as it would seem, to be the quarter where this action was oftenest repeated, and where at each epoch of disturbance, especially that which witnessed the final drainage of the Apalachian sea, it was greatly the most energetic. The whole structure of the Apalachian chain supports this conclusion; the truth of which is confirmed by the excessively folded and dislocated condition of the strata along this whole belt of country, and the gradation to features of less and less disturbance as we cross the strata westward still further, by the progressive flattening of the anticlinal arches, by the decreasing amount of crystallization in the rocks, and even the increasing quantity of the volatile bitumen in the coal. When we advert to this repetition of igneous action along this chief belt of volcanic force, upon the early elevated Primal and Matinal deposits, we can no longer wonder at their highly metamorphic condition, nor hesitate to impute to such cause any extent of lithological alteration exhibited by portions of the strata, even to the aping of true granite and gneiss.

The suggestion we have here made, that the Primal and Matinal rocks of the White Mountains emerged from the waters in the Levant period, and were elevated into anticlinal and synclinal flexures with a different strike from those of the more extensive crust undulations of the late carboniferous date, offers a natural cause, we think, for the superior elevation of their outcrops in this mountain chain, compared with their height in the Green Mountains and other districts where only one system of axes, up-

on a large scale, is discernible. As the level of the water is highest at the intersection of two crossing billows, we can understand why in a region of two interfering sets of dips or archings in the strata, such as we see indicated in the great defile of the Saco, there should coexist a series of loftier peaks than are any where else presented in the general mountain chain. The same intersection of axes of different geological dates has probably produced in like manner the very elevated and pyramidal group of mountains between Lake Champlain and Lake Ontario, to which the general name of the Adirondack range is given. The prodigious elevation and insulation of the peaks of the Alps have likewise manifestly originated in the want of coincidence in the great folds or axes, during the successive movements of elevation.

SCIENTIFIC INTELLIGENCE.

I. Chemistry.

1. *On new Magnetic Actions, and on the Magnetic Condition of all Matter;* by Michael Faraday, Esq., D. C. L., F. R. S., &c. "Experimental Researches in Electricity," 20th series, sect. 26th. (Phil. Mag., Feb. 1846, xxviii, 147.)—The following is the order in which the several divisions of the subject treated of in this section of the author's researches in electricity, succeed one another:—1. Apparatus required. 2. Action of magnets on heavy glass. 3. Action of magnets on other substances acting magnetically on light. 4. Action of magnets on the metals generally. 5. Action of magnets on the magnetic metals and their compounds. 6. Action of magnets on air and gases. 7. General considerations.

In giving an account of the contents of this paper, any attempt to follow the track of the author in the precise order in which he relates the consecutive steps of his progress in this new path of discovery, would fail of accomplishing its object: for, by adhering to such a course, it would scarcely be possible to comprise within the requisite limits of an abstract, the substance of a memoir extending, as the present one does, to so great a length, and of which so large a portion is occupied with minute and circumstantial details of experiments; or to succeed in conveying any clear and distinct idea of the extraordinary law of nature brought to light by the author, and of the important conclusions which he has deduced.

One of the simplest forms of experiment in which the operation of this newly discovered law of magnetic action is manifested, is the following:—A bar of glass, composed of silicated borate of lead, two inches in length and half an inch in width and in thickness, is suspended at its centre by a long thread, formed of several fibres of silk cocoon, so as to turn freely, by the slightest force, in a horizontal plane, and is secured from the agitation of currents of air by being enclosed in a glass jar. The two poles of a powerful electro-magnet are placed one on each side of the glass bar, so that the centre of the bar shall be in the line connecting the poles, which is the line of magnetic force. If, previous to the establishment of the magnetic action, the position of the bar be such that its axis is inclined at half a right angle to that line, then, on completing the circuit of the battery so as to bring the magnetic power into operation, the bar will turn so as to take a position at right angles to the same line; and, if disturbed, will return to that position. A bar of bismuth, substituted for the glass bar, exhibits the same phenomenon, but in a still more marked manner. It is well known that a bar of iron, placed in the same circumstances, takes a position coincident with the direction of the magnetic forces; and therefore at right angles with the position taken by the bar of bismuth subjected to the same influence. These two directions are termed by the author *axial* and *equatorial;* the former being that taken by the iron, the latter that taken by the bismuth.

Thus it appears that different bodies are acted upon by the magnetic forces in two different and opposite modes; and they may accordingly be arranged in two classes: the one, of which iron is the type, constituting those usually denominated *magnetics;* the other, of which bismuth may be taken as the type, obeying a contrary law, and therefore coming under the generic appellation of *diamagnetics*. The author has examined a vast variety of substances, both simple and compound, and in a solid, liquid, or gaseous form, with a view to ascertain their respective places and relative order with reference to this classification. The number of simple bodies which belong to the class of magnetics is extremely limited, consisting only of iron, which possesses the magnetic property in an eminent degree, nickel, cobalt, manganese, chromium, cerium, titanium, palladium, platinum and osmium. All other bodies, when either solid or liquid, are diamagnetic; that is, obey the same law, with regard to magnetic action, as bismuth, but with various degrees of intensity: arsenic is one of those that give the feeblest indications of possessing this property. The following exhibit it in increasing degrees, according to the order in which they are here enumerated; namely, ether, alcohol, gold, water, mercury, flint glass, tin, lead, zinc, antimony, phosphorus, bismuth. On the other hand, no gas-

eous body of any kind, or in any state of rarefaction or condensation, affords the slightest trace of being affected by magnetic forces. Gases may therefore be considered as occupying the neutral point in the magnetic scale, intermediate between magnetic and diamagnetic bodies.

The magnetic properties of compound bodies depend on those of their elements; and the bodies are rendered either magnetic or diamagnetic according to the predominance of one or other of these conditions among their constituent parts. Thus iron is found to retain its magnetic power when it has entered into combination with other bodies of the diamagnetic class; the two forces acting in opposition to one another, and the resulting effect being only that due to the difference in their power. Hence the oxides and the salts of iron are still in a certain degree magnetic, and the latter even when they are held in solution by water; but the water may be present in such a proportion as that neither shall prevail; and the solution, as far as respects its magnetic properties, will then be exactly neutralized. These saline solutions, prepared of various degrees of strength, also afford a convenient method of comparing the relative degrees of force, both magnetic and diamagnetic, of different bodies, whether solid or fluid, but more especially the latter, as they admit of the body under examination being suspended in another liquid, when its position of equilibrium will indicate which of the two substances has the strongest magnetic power.

In one respect, indeed, the diamagnetic action presents a remarkable contrast with the magnetic; and the difference is not merely one of degree, but of kind. The magnetism of iron and other magnetics is characterized by polarity; that of diamagnetics is devoid of any trace of polarity; the particles of two bodies of the latter class, when jointly under the influence of the magnetic forces, manifest towards each other no action whatever, either of attraction or repulsion. It has long been known that the magnetism of iron is impaired by heat; and it has been generally believed that a certain degree of heat destroys it entirely. The author finds, however, that this opinion is not correct; for he shows that, by applying more powerful tests than those which had been formerly confided in, iron, nickel and cobalt, however high their temperature may be raised, still retain a certain amount of magnetic power, of the same character as that which they ordinarily possess. From the different temperatures at which the magnetic metals appear to lose their peculiar power, it had formerly been surmised by the author, that all the metals would probably be found to possess the same character of magnetism, if their temperature could be lowered sufficiently; but the results of the present investigation have convinced him that this is not the case, for bismuth, tin, &c. are in a condition very different from that of heated iron, nickel or cobalt.

The magnetic phenomena presented by copper and a few other metals are of a peculiar character, differing exceedingly from those exhibited by either iron or bismuth, in consequence of their being complicated with other agencies, arising from the gradual acquisition and loss of magnetic power by the iron core of the electro-magnet, the great conducting power of copper for electric currents, and its susceptibility of being acted upon by induced currents of magneto-electricity, as described by the author in the first and second series of these researches. The resulting phenomena are to all appearance exceedingly singular and anomalous, and would seem to be explicable only on the principles referred to by the author.

Pursuing his inductive inquiries with a view to discover the primary law of magnetic action from which the general phenomena result, the author noticed the modifications produced by different forms given to the bodies subjected to experiment. In order that these bodies may set either axially or equatorially, it is necessary that their section, with reference to the plane of revolution, be of an elongated shape: when in the form of a cube or sphere, they have no disposition to turn in any direction: but the whole mass, if magnetic, is attracted towards either magnetic pole; if diamagnetic, is repelled from them. Substances divided into minute fragments, or reduced to a fine powder, obey the same law as the aggregate masses, moving in lines which may be termed *diamagnetic curves*, in contradistinction to the ordinary magnetic curves, which they every where intersect at right angles. These movements may be beautifully seen by sprinkling bismuth in very fine powder on paper, and tapping on the paper while subjected to the action of a magnet.

The whole of these facts, when carefully considered, are resolvable, by induction, into the general and simple law, that while every particle of a magnetic body is attracted, every particle of a diamagnetic body is repelled, by either pole of a magnet. These forces continue to be exerted as long as the magnetic power is sustained, and immediately cease on the cessation of that power. Thus do these two modes of action stand in the same general antithetical relation to one another as the positive and negative conditions of electricity, the northern and southern polarities of ordinary magnetism, or the lines of electric and of magnetic force in magneto-electricity. Of these phenomena, the diamagnetic are the most important, from their extending largely, and in a new direction, that character of duality which the magnetic force was already known, in a certain degree, to possess. All matter, indeed, appears to be subject to the magnetic force as universally as it is to the gravitating, the electric, the cohesive and the chemical forces. Small as the magnetic force appears to be in the limited field of our

experiments, yet when estimated by its dynamic effects on masses of matter, it is found to be vastly more energetic than even the mighty power of gravitation, which binds together the whole universe: and there can be no doubt that it acts a most important part in nature, and conduces to some great purpose of utility to the system of the earth and of its inhabitants.

Towards the conclusion of the paper, the author enters on theoretical considerations suggested to him by the facts thus brought to light. An explanation of all the motions and other dynamic phenomena consequent on the action of magnets on diamagnetic bodies, might, he thinks, be offered on the supposition that magnetic induction causes in them a state the reverse of that which it produces in magnetic matter: that is, if a particle of each kind of matter were placed in the magnetic field, both would become magnetic, and each would have its axis parallel to the resultant of magnetic force passing through it; but the particle of magnetic matter would have its north and south poles opposite to, or facing the contrary poles of the inducing magnet; whereas, with the diamagnetic particles, the reverse would obtain; and hence there would result, in the one substance, approximation; in the other, recession. On Ampère's theory, this view would be equivalent to the supposition that, as currents are induced in iron and magnetics, parallel to those existing in the inducing magnet or battery wire, so, in bismuth and other diamagnetics, the currents induced are in the contrary direction. As far as experiment yet bears upon such a notion, the inductive effects on masses of magnetic and diamagnetic metals are the same.

2. *Researches on the Relations of Light and Magnetism;* by M. Faraday, Royal Institution, Jan. 23—(Athenæum, No. 953, Jan. 31, 1846, p. 126.)—We shall confine ourselves to the method by which Prof. Faraday exhibited the great fact of his researches—*the rotation of a ray of light by magnetic force.* The well known oxy-hydrogen light of Drummond supplied the ray. This light was so directed by an arrangement furnished by Mr. Darker, as to make distinctly visible, over the whole theatre, all the phenomena of circular polarization which were required to illustrate Prof. Faraday's newly discovered principle. A beam of common light was shown to be separable into two distinct rays of polarized light; and the properties of these, and their relation to each other, were repeatedly demonstrated to the spectators. Such being the subject of his operations, Prof. Faraday next exhibited the nature and extent of the force employed to accomplish his results. That force is magnetism derived from an electro-magnet of immense size and power. The magnet used was a half link of the former East India moorings, surrounded by several coils of thick copper wire, and the source of electric power was Grove's battery, about

twenty cells of which were employed on this night. To give an idea of the force of this electro-magnet, Prof. Faraday mentioned that once, while he was at work in the laboratory, an iron candlestick which happened to be standing on the table near its poles, instantly flew to them, attracted with such violence as to displace or break every thing in its way. The great experiment of the evening was then successfully tried. A prism of heavy glass was so adjusted between the poles of the magnet, as to receive the oxy-hydrogen light after it had been polarized, and before it was depolarized by Nicholl's eye-piece. The following facts, demonstrating the magnetism of light, were then exhibited:

1. As to the *rotation* of the ray.—A polarized ray, having been extinguished by the depolarizing plate, was instantaneously restored when the magnetic current was sent through the prism through which the ray was transmitted: and conversely, the polarized ray, when, by the common adjustments of the plate, it had been made visible, was extinguished by the force of the current.

2. As to the relations of this electro-magnetic power to other laws of polarized light.—The rotation having been established, it was shown, (*a.*) That the direction of the rotation was absolutely dependent on that of the magnetic force. (*b.*) That, while in common circular polarization, the ray of light always rotates in the same direction *with regard to the observer*, (to whatever part of the medium his view may be directed,) it is very different in the state of the ray induced by this new force. When brought under the influence of the magnetic current, polarized rays always rotate in a constant direction with respect, *not to the observer, but to the plane of the magnetic curves.*

Prof. Faraday concludes, by throwing out some general notions as to the possible development of these researches in the line of future investigations. It did not seem impossible to him, that the sun's rays might be found to originate the magnetic force of the earth, and the air and water of our planet might be proved to be the diamagnetic media in which this condition of the force was eliminated.

M. Pouillet has repeated the experiments of Faraday, and communicated a report to the Academy of Sciences of Paris, (L'Institut, No. 630.) He is of the opinion that the phenomena are due to action on the transparent medium, or upon the forces which govern its molecules, and not on the luminous ray itself.

3. *Sound from vibration of soft iron, produced by a galvanic current*, (L'Institut, No. 634, Feb. 1846, p. 65.)—This singular phenomenon, discovered by Mr. Page, and verified by M. Marrian, has been studied since by de la Rive and Matteucci. These authors have attributed the

sound to a vibration in the interior of the iron bar, or a new arrangement of the molecules; but they are not agreed on the mode of vibration; de la Rive believing it to be transversal, and Matteucci endeavoring to prove it to be longitudinal. M. Wertheim, after a series of experiments, has ascertained that there are at times, both longitudinal and transverse vibrations. His experiments were made with a bar of iron two meters long and one centimeter thick, which was fixed at middle in a horizontal position, and had each half enclosed in a large glass tube, which tubes were wound with a spiral of copper wire. A coil of copper wire (1336 metres in length, and 19 centimeters in its inner diameter) was afterwards substituted for the two helices, and placed with its axis coincident with the axis of the bar. On completing the circuit, the longitudinal sound, although feeble, could be distinguished, and the bar was a little lengthened in the direction of the axis. When the axis of the coil was one side of the centre, the bar was attracted and bent toward it, and resumed its first position only on the cessation of the current. Thus by varying the position of the coil, the bar could be bent horizontally or vertically, or in an intermediate position, and the flexure amounted to several millemeters. In opposition to the deduction of Guillemin, from his experiments, M. Wertheim has shown that the elasticity of iron is diminished by magnetization. He is preparing to ascertain by direct micrometrical investigation, the amount of elongation which the iron bar is believed by him to undergo.

M. Guillemin, in the experiments alluded to, found that a bar of iron wound with a spiral of copper wire, supported at one end and bent by a weight suspended from the other, sensibly straightened itself, on the passage of a magnetic current through the copper wire.

4. *Electric excitement of paper;* by Rev. H. G. O. Dwight, (communicated.)—It is well known that friction will excite electricity in a sheet of paper, especially if it be thoroughly dry. This is well shown by placing the paper on a warm stone, for a moment, when a single passing of the palm of the hand will produce electric excitement. On raising the paper carefully from the stone, sparks may be obtained from different parts of it by the knuckle. If a piece of tin plate be placed on the paper arranged on the stone, and pressed down, on raising the whole carefully, a strong spark is procured; and if it be returned to the stone, and the plate again pressed strongly upon the paper, another spark is given out on again raising it.

If the sheet of paper with the tin plate mentioned above, be charged as just explained, and then be removed carefully, and placed on a sheet of tinfoil upon the top of an insulated stool, and pressed down with a finger at the centre,—on raising it, a strong spark will be obtained from the tinfoil, and another from the lower surface of the tin plate through the paper. This simple electrical machine may be again charged by

returning the paper to the stone, and pressing the tin plate down upon it with the hand.

5. *On a New Process for obtaining pure Chlorine Gas;* by Profs. R. E. Rogers, and W. B. Rogers, of the University of Virginia, (communicated by the authors.)—This process is founded on the powerful oxidating action of chromic acid, especially when liberated in a solution, and consists in causing a reaction between hydrochloric acid and this substance, in which the chlorine of the former is set free. Our mode of proceeding is as follows.

To 1 part of powdered bichromate of potassa, in a small retort or flask, we add 6 parts of hydrochloric acid, of specific gravity about 1·16, and apply a gentle lamp heat for a few seconds, so as to bring about a brisk reaction. The chlorine is now rapidly evolved, and continues to be disengaged as fast as is convenient, without requiring any further application of the lamp.

Referring to the composition of the bichromate of potassa and of hydrochloric acid, it will be seen that *one equivalent of bichromate of potassa and seven of hydrochloric acid, are capable of evolving three equivalents of chlorine*, at the same time giving rise to one equivalent of the sesquichloride of chromium, one of the chloride of potassium, and seven of water.

In order to ascertain how near we might approach to the equivalent quantity of chlorine above deduced, we resorted to the following method. Knowing that a strong solution of chloride of sodium is much less absorbent of the gas than ordinary water, we prepared a quantity of saturated brine, through which we passed chlorine, until the liquid appeared to be fully charged. With this we filled a tall graduated vessel, designed to receive the gas, and a porcelain bowl, which served as a pneumatic trough, and having placed 4 grammes of the bichromate with an excess of hydrochloric acid in a small retort, we passed the gas as it was evolved through the chlorous saline solution into the narrow graduated jar. After urging the process until the action entirely ceased, and no further gas escaped, we measured the resulting gas with the usual precautions, at 60°. Its volume was found to be 54·5 cubic inches. On repeating the experiment with the same amount of bichromate and acid, and with the same brine, we obtained in the second trial 55·5 cubic inches, and in the third 56·2 cubic inches of the gas, the increase being evidently due to the diminished absorption arising from the more complete saturation of the liquid with chlorine.

Taking 76·5 grains as the weight of 100 cubic inches of chlorine, at 60° Fahr., the volume due to the entire decomposition of 4 grammes of bichromate of potassa, is 57·3 cubic inches. It thus appears that with proper precaution, this process may be made to yield $\frac{5}{6}$ths, or nearly the whole theoretical amount of the gas.

6. *Radiant Heat*, (L'Institut, No. 629, Jan. 21, 1846, p. 22.)—M. Knoblauch, of the Academy of Sciences of Berlin, has found by experiment, that the diathermal modifications which heat undergoes by reflexion differ according to the source of the heat; that (1) these modifications are quite decided with heat from an argand lamp; (2) they are much less for heat from incandescent platina; (3) they are still less for the heat from an alcoholic lamp; and that (4) none whatever can be distinguished for heat from a cylinder of iron heated between 68° and 320° F.

These modifications depend either on a transformation of the calorific rays, rendering them more or less transmissible across diathermal substances; or they result from an elective absorption by the reflecting surfaces, a view rendered probable by the experiments of Powell and Melloni. Experiment has shown that carmine facilitates the passage of heat across calc spar. If this effect is owing to its absorbing those rays which traverse calc spar with difficulty, it ought to reflect as much less perfectly the heat from a source which affords those rays that traverse the spar with difficulty. Now, it is found that heat from the cylinder of iron traverses calc spar much less completely than that from an argand lamp; consequently carmine, in case of an elective absorption, ought to reflect the heat of the iron less perfectly than that of the lamp. This is fully confirmed by experiment.

7. *Milk of the Milk tree*, (L'arbre de vaches, Galactodendrum utile.)—An analysis of this vegetable milk, afforded M. Heintz the following result: water 57·3, vegetable albumen 0·4, a species of wax (having the formula $C^{35}\,H^{66}\,O^{8}$) 5·8, a resin soluble in cold or boiling alcohol (corresponding to the formula $C^{35}\,H^{58}\,O^{2}$) 31·4, gum and a kind of sugar 4·7, bases resisting the action of heat, such as magnesia, soda, traces of potash and lime combined with phosphoric acid, and an organic acid undetermined 0·4=100. This agrees nearly with the analyses of MM. Boussingault and Mariano; but differs so much from that by M. Marchand, that M. Heintz suspects he may have examined the milk of another species of plant.

8. *Artificial Asbestus*, (Proceedings Phil. Soc. of Glasgow.)—A specimen of this substance was found in a blast furnace, imbedded in the mass of matter which had collected at the bottom of the furnace, in the course of two years and a half. It was in a cavity about eight inches below the level on which the liquid metal rested, and was interspersed with beautiful crystals of titanium. It has the general character of asbestus, forming small masses, consisting of delicate filaments or fibres easily separable. The fibres are flexible, though not so much so as common asbestus; they fuse with difficulty, and are not attacked by sulphuric, nitric or muriatic acid.

9. *Artificial Aventurine;* by MM. FREMY and CLEMANDAT, (L'Institut, No. 624.)—The process for making aventurine has been hitherto a secret with the glass establishments at Venice. It has been known that the peculiarities of it are due to disseminated crystals of copper. M. Fremy, after various experiments, has found that it may be imitated by mixing with glass, and heating for some hours, a portion of protoxyd of copper and protoxyd of iron. Reaction deoxydizes the copper and leaves it in delicate crystalline points; while the iron becomes a peroxyd, and but slightly tinges the glass with yellow. The specimens thus far obtained have a slight opacity, which makes them inferior to the Venice aventurine, although similar in other respects.

10. *Specular Iron artificially produced*, (L'Institut, No. 634, Feb. 1846, p. 72.)—The theory for the formation of crystals of specular iron in the fissures of volcanic rocks through the agency of chlorine, proposed and explained by Mitscherlich, has been lately confirmed by a singular phenomenon at the salt mines of Wieliczka. The supporting wood-work through these vast mines was some time since consumed by fire, and the iron tubes suffered more or less. After the fire, some specimens of saliferous clay were obtained from the parts which had been exposed to the heat, which were traversed with fissures covered with implanted crystals of specular iron.

11. *Bromide and Chloride of Silver in ancient coins*, (L'Institut, No. 634, Feb. 1846, p. 72.)—M. Bruel of Hanover states, as the result of some analyses by him of ancient coins, that they contained bromide and chloride of silver. These substances were found to occur in the greatest quantity in Greek and Saxon coins of the thirteenth century, but they were detected also in Roman coins. M. Bruel suggests that these ingredients may not have existed in the original coin, but were received from without while buried.

II. MINERALOGY AND GEOLOGY.

1. *On certain Pseudomorphous Crystals of Quartz;* by R. W. Fox, (Jameson's Jour. Jan. 1846, p. 115.)—Crystals of quartz are stated by Mr. Fox to have been found at the Consolidated mines, in a copper vein, which contained regular octahedral pseudomorphous crystals of quartz, and others which enclosed a considerable quantity of liquid. In two of them, common salt was detected, though but slightly saline to the taste. The liquid of others was acrid and contained sulphuric acid, iron, muriatic acid, and lime.

Many of these pseudomorphs were more than an inch in diameter, and were partly or entirely filled with crystalline quartz; while others were empty, or contained more or less numerous fragments of disintegrated fluor. Nearly a hundred such fragments were taken from one of

the crystals; and all appeared to *have been corroded as by some solvent.* This solvent must have reached the fluor after the quartz crystals were formed about them, and the resulting solution passed off at the same time. Some contained translucent fragments of carbonate of iron along with the fluor.

The specimens of quartz to which the crystals were attached consisted of successive layers of different colors, and appeared to have been formed by depositions at distinct intervals. At another time, an entire change of condition must have occurred in the vein, in which octahedral crystals of fluor were formed on the quartz. Again silex was deposited on the fluor; and then fluor again upon the quartz. These processes appear from some of the crystals to have been several times repeated, and then came a coating of silex on the fluor, apparently in many successive depositions.

Mr. Fox supposes that these changes have taken place through the action of steam, which may exist in fissures below the water at great depths, from the agency of internal heat; and the alternate depositions may have proceeded from the struggle which would take place between the steam and water above, the one encroaching at intervals on the other. These views are thus presented:—

I have, on former occasions, alluded to various causes which would produce circulation in the subterranean waters, such as the opening or closing of any portions of fissures; the ascent of warm, and the descent of cooler currents of water, in consequence of the differences in their specific gravities; or in some instances, by the pressure of sea water acting on the fresh. Nearly two years ago, I stated in this room, my views in reference to the operation of this latter cause on land springs; and at the same time, I attempted to show the possibility, not to say probability, of steam existing in fissures *below* the water at a very great depth. I may, perhaps, be permitted to refer again to this subject, because it appears to me to be one of some interest. I then took it for granted that the temperature of the earth increases, in some proportion to the increase of the depth below its surface; and that if the ratio be taken at 1° Fah. for every 48 feet, as found in our deep mines; and if Le Roche's data for calculating the elastic force and density of steam be adopted, the forces of steam and of water pressure would balance each other at rather more than nine miles deep, each being equal to the pressure of more than 1400 atmospheres. The density of the steam would there be about one-fourth that of water at 60° Fah., and its temperature above 1050° Fah. But the temperature may probably not increase so rapidly as this at great depths, and the equilibrium in the pressures of the column of water and of steam, may occur much further below the surface, where the density of steam, under an augmented

pressure of water, would, of course, be still greater. However this may be, it would seem that, under any probable circumstances, in regard to the ratio of increase in the earth's temperature, the increase in the pressure of the lengthened column of water would not keep pace with the rapidly increasing tendency of the water in descending into more heated parts of the earth to expand into steam, the elasticity of which, at very high temperatures, when confined and in contact with water, is greatly augmented by very small increments of sensible heat.

No water could long remain unchanged into steam below the line of division between them, and there the steam would be denser than at any deeper station, for it would be continually diminishing in density, in descending further from the augmentation of the temperature of the earth; because the *expanding* influence of the increasing heat would much exceed the *condensing* influence of the extended column of steam, added to that of the nearly constant column of water.

The line of demarcation between the water and steam would, doubtless, conform in some degree to the inequalities of the surface. It may be difficult, at first, to conceive the steam capable of supporting the water, or rather of existing permanently under it; but this difficulty will, I think, be obviated by the consideration that the points of contact may be, for the most part, in very narrow fissures, or mere cracks in the rocks, and that the water, being greatly heated, may be much less than *four times* the density of the steam in immediate contact with it. A continual struggle would, no doubt, exist between the water and steam under such circumstances, so that, in many places, they would alternately encroach beyond the line of demarcation; but as the checks on both would increase in proportion to the extent of their encroachments, from the diminution of the temperature above, and its augmentation below, such encroachments would probably not be very extensive or of long duration under ordinary circumstances. Suppose a temporary encroachment of the water on the limits of the steam to occur at one point; the steam would probably encroach on the water at another at the same time, and then reactions taking place, the effects would be reversed. Thus assuming, what indeed would appear to follow from *admitted data as necessary consequences*, steam would not only exist below the water, but such oscillations would tend to give motion and activity to the water in the neighboring fissures, causing it to circulate in the earth more or less freely and extensively according to circumstances. In volcanic districts, where the heat may be great at comparatively small depths, analogous phenomena sometimes occur at the surface, which are probably caused by the action and reaction of steam and water. Amongst these may be included the intermitting Geyser springs in Iceland, as well as some of the mud volcanoes found in Sicily, and in Asia and America.

2. *Petrified Forest near Cairo;* (Athenæum, Jan. 1846, p. 130.)—The following particulars are from an account given by Dr. Buist, of Bombay, in explanation of some specimens of silicified wood presented by him to the Literary Society of St. Andrews:—"The specimens consisted of about forty-five pieces of wood;—trunks, roots, knots and branches, from three inches to three feet in length; some were exhibited sliced and transparent, showing the sap vessels and the medullary rays; some cut into bracelets and brooches. In explaining the peculiarities of these, Dr. Buist stated that few things were more remarkable—few less noticed (considering how worthy it was of examination,) than the petrified forest near Cairo. From the city you proceeded, by the Caliphs' Tombs, to the southeast. Passing for five miles through an arid valley, through which a river torrent appeared to have flowed, skirted on both sides by low, brown, rocky ridges, the traveller turns suddenly off to the right, and beyond the first range of sand-hills, finds, spreading far as the eye can reach, a vast expanse of rolling hillocks, covered with prostrate trees. At first sight these wear exactly the aspect of rotten wood dug out from a Scottish or Irish peat-bog. The color and the amount of decay seem the same. They are lying in all positions and directions on the surface of the burning sand—some forty or fifty feet in length, and one or two feet in thickness; not continuous or entire, but in a line broken across, left in their places like sawn trunks. On touching them, instead of proving mouldering and decayed, they turn out to be hard and sharp as flints. They ring like cast-iron, strike fire with steel, and scratch glass. The sap-vessels and medullary rays—the very bark and marks of worms and insects, and even the spiral vessels, remain entire; the minutest fibres of the vegetable structure are discernible by the microscope. Here you have the carbon—the most indestructible matter known to us—entirely withdrawn, and substituted in its place a mass of silica—a matter insoluble by any ordinary agent, and at any common heat. Yet so tranquilly has the exchange been accomplished, that not one atom has been disturbed; the finest tissues remain entire—the most delicate arrangements uninterfered with. The limits of the petrified forest are unknown: it probably extends over an area of many hundreds, perhaps thousands of miles. It has never been described with any care, and, extraordinary as it is, has excited very little attention. The trees are scattered loosely and at intervals over the desert all the way from Cairo to Suez, a distance of 86 miles. No theory of their silicification or their appearance where they are found, has ever been attempted. The late Dr. Malcolmson found fragments of the wood imbedded in the conglomerate which contains the Egyptian jaspers, and threw it out as possible that they and the gravel of the Desert, consisting almost entirely of jas-

pers, might possibly be the result of abrasion or denudation. This threw the difficulty only one step further back; besides this, that the appearance of the forest is at variance with the theory. No agates or gravel appeared around; the trees seemed to have been petrified as they lay; they looked 'like a forest felled by mighty winds.' A further mystery was this: they lay on the surface of bare drift sand and gravel, and reposing on limestone rocks of the most recent tertiary formation—the texture and color of the imbedded oyster shells were as fresh and pure as if brought not six weeks from the sea."

3. *Cuchullin Hills in Skye.*—The Cuchullin Hills are described by Prof. FORBES, (Jameson's Jour., Jan. 1846, p. 76,) as consisting largely of hypersthene rock, which forms a vast bed, and passes insensibly into one or other of the varieties of trap rocks; and this rock is intersected by numerous veins of claystone, of a dull gray color. The smoothing or planing of the rocks in some places, and the regular furrowings, parallel and strongly marked, which occur on some high vertical cliffs, and rise against opposing promontories, or channel the trough of the valley, are described as very similar to what he had before shown to be a necessary result of glacier action: and to this cause, Prof. Forbes is disposed to refer them. The Cuchullin range is remarkable for its fantastic outline, and is compared to the granite mountains of Dauphiné; and "one part in particular resembles the Montagne de la Grave, aptly likened by M. Elie de Beaumont, to a gigantic nut-cracker, menacing heaven with its open jaws."

4. *Gradual rise of Newfoundland above the sea.* (Jameson's Jour. Jan. 1846, p. 206.)—It is a fact worthy of notice, that the whole of the land in and about the neighborhood of Conception Bay, very probably the whole island, is rising out of the ocean at a rate which promises, at no very distant day, materially to affect, if not to render useless, many of the best harbors we have now on the coast. At Port-de-Grave a series of observations have been made, which undeniably prove the rapid displacement of the sea-level in the vicinity. Several large flat rocks, over which schooners might pass some thirty or forty years ago with the greatest facility, are now approaching the surface, the water being scarcely navigable for a skiff. At a place called the Cosh, at the head of Bay Roberts, upwards of a mile from the sea-shore, and at several feet above its level, covered with five or six feet of vegetable mould, there is a perfect beach, the stones being rounded, of a moderate size, and in all respects similar to those now found in the adjacent land-washes.—(From the Newfoundland Times.)

5. *Cataract Cave, Schoharie,* (from a published account, communicated by A. EGGLESTON.)—The Cataract cave was first opened about two years since, by a young man of the name of Howe. The opening when

first noticed, was but little larger than a man's arm; but after arduous labor for some hours, he succeeded in making his way into a passage where he could stand erect, and continuing on, numerous chambers were discovered, of great extent and beauty. The main avenue has been since examined to a distance of seven miles. One of the innermost rooms, (six miles from the entrance,) which has been named the *Rotunda*, is 30 or 40 feet in diameter, and is said to be 500 feet in height. Beyond this there was another rotunda about 12 feet in diameter, and several hundred feet high. The chambers are splendidly arrayed in stalactites and stalagmites, many of which are of gigantic dimensions. Thousands of bat's bones covered the bottom in some places, and many were imbedded in the stalagmite. About a mile from the entrance, and half a mile from the main avenue, there is a fall of water, of great magnitude, whose roaring in these subterraneous recesses, has been compared to Niagara; the cave is named, from this fall, the Cataract Cave. The rock in which it occurs is limestone.

6. *Geological Survey of Vermont.*—Arrangements have been made for the active prosecution of the field labor of this survey the ensuing season, under the charge of Prof. Adams, whose first report has already been announced by us. Mr. D. Olmsted, Jr., an expert mineralogist and good chemist, attached to the laboratory of Yale College, has been associated with Prof. Adams in the survey. Vermont abounds in rich architectural marbles of many varieties, and other sources of mineral wealth, but their full value cannot be estimated until they have been ably developed by a geological and mineralogical survey.

A fresh scientific interest is now shed on the explorations of this state, since Prof. H. D. Rogers (see his paper at p. 411 of this volume) has demonstrated that fossils exist in the White Mountain strata, which have, almost by common consent, been hitherto looked on as among the oldest *non-fossiliferous* rocks in America, and fully entitled to the epithet of *primary*. We have before us the first essay toward a colored geological map of the state of Vermont, made up from the labors of the past year, with the aid of what has been already determined by Prest. Hitchcock and others. It is interesting to observe from it, the general conformity of trend in the great formations of this section, to those of Massachusetts and Connecticut.

7. *Stigmaria.*—Another instance of the occurrence of Stigmaria on the roots of Sigillaria, has lately been brought under the notice of the Geological Society of London, by Mr. Dawson. In the Pictou coal-field in Nova Scotia, Sigillaria and Stigmaria are abundant; and one large erect trunk of Sigillaria was discovered with roots extending into the bed of under-clay, and these roots were decided Stigmaria; specimens were laid before the Society.

8. *Pterodactyl in the English Chalk.*—Portions of the jaws with teeth, and of several characteristic bones of the extremities of a Pterodactyl, have recently been discovered in the chalk of Kent, England, in a locality that has furnished the large bones which have hitherto been taken for those of a bird as large as an Albatross, but which probably belong to a flying reptile.

III. Zoology.

1. *On the Formation of Cells;* by M. Coste, (Ann. Mag. Nat. Hist., xvii, p. 94, from Comptes Rendus, Dec. 22, 1845.)*—The most appropriate examples for supplying the necessary means for resolving the difficult problem of the formation of cells, should be found in those parts where the matter undergoes that primary elaboration which prepares the materials of the new individual. Hence the bases for its solution must be sought in the metamorphoses of the *vitellus*, and we there find the facts developed in so characteristic and evident a manner, that they may be verified by any one. But, before showing how it is that the amorphous matter assumes the cellular form, there is another condition of that matter, the history of which I shall rapidly trace, and with which it is not less important to be acquainted. I allude to that progressive subdivision by means of which it is employed for the production of organic spheres, which must be considered hereafter as special elements of the living tissues. We shall proceed then, first, to study the mode of generation of these spheres in the *vitellus* of Mammalia, subsequently tracing it wherever it occurs. When, in Mammalia, the seminal fluid has passed through the uterus and reached the Fallopian tubes so as to envelope the ovum with its moving molecules, in proportion as the molecules penetrate its substance, we see the yolk undergo the primary modifications which are about to induce the organization of the germ. It commences by becoming concentrated into a smaller volume, and forming itself into a granular globe so perfectly spherical and correctly outlined, that all the grains of which this globe is composed, and which are united together by means of a viscid diaphanous fluid, are apparently retained in the general form which their assemblage represents, by a delicate layer of the same fluid, which appears at the periphery as the representative of an enveloping membrane. But if, after having sufficiently guarded against optical illusions, we endeavor to develope the reality of the appearances which obscure it, we soon recognize that such a membrane does not exist, and that those observers, as for instance Barry, who have admitted its existence, have not pursued their

* This paper is a continuation of M. Coste's researches, an account of which is given at p. 281 of the present volume.—*Eds. Am. Jour.*

examination with sufficient care. Their error here evidently arises from their having considered the superficial part of the viscid matter which retains the granulations mingled in its own substance as an enveloping membrane. This matter is in fact merely lodged in the interstices of the granulations which it agglutinates, and which it separates so regularly that it appears at first sight to form a wall at the periphery of the *vitellus*, the outline of which appears more distinctly delineated in proportion as its transparence contrasts with the opacity of the granulations which it bounds. But, I repeat, this is an illusion which an attentive analysis corrects, and on this point I have sufficiently repeated my observations to have a well-founded conviction.

The *vitellus* is not then, as has been supposed, a vesicle or cell filled with granules, but simply a granular homogeneous sphere, the whole of the grains of which are kept agglutinated by a diaphanous interstitial matter, the retraction of which matter gives the whole mass the somewhat geometric regularity which it assumes.

Soon (a few hours are sufficient for the accomplishment of this phenomenon) the vitelline sphere divides it into two nearly equal parts, each of which, immediately rendered spherical in form by the centripetal retraction of the viscosity which retains its granulations in union, presents the same aspect and the same composition as the whole from which it emanates.

This primary division is scarcely accomplished before the two secondary granular spheres which are thus formed by a primary division of the *vitellus* become in their turn the seat of a similar division, and the same phenomenon being repeated during a certain time upon each new segment, the *vitellus* is finally resolved into a considerable number of granular spheres of a progressively diminishing volume, but always of the same nature. However Reichert, who has made some special researches upon the division of the *vitellus* of the Batrachia, believes he has observed that each segment is a true cell possessing an enveloping membrane and granular contents. According to him, the phenomenon of the division of the yolk would then have a totally different signification to that which we have given, and would essentially be nothing more than an illusion produced by the liberation of the pre-existing vesicles which were inclosed one within another. The *vitellus*, in his view, would at first represent a mother-cell, the wall of which, when ultimately absorbed, would expose to view two inclosed vesicles which form its contents; these two vesicles having thus become free would be dissolved in their turn, and each of them would allow two other vesicles to escape, which would produce an appearance of a division of the yolk into four segments, and so on, until the completion of this illusory division arrived. But although this hypothesis appears to

explain a phenomenon until then but little understood, and to corroborate the theory of the exclusive intervention of the cells for the formation of the tissues, it does not follow that we must accept it without examination, and solely from its being reconcilable with an accredited system. I have therefore examined the question with all that care which its importance demands, and, after the most minute researches, I am perfectly convinced that the segments of the *vitellus* or the granular spheres are not real cells. Consequently Barry and Bergmann were deceived when they admitted the contrary.

When the subdivision of the *vitellus* is completed, a process ensues in each of the granular spheres resulting from this division which converts them into true cells. But before arriving at this degree of organization, as we have seen, the living matter had assumed regular forms, and in each vitelline sphere had acquired a generating activity which becomes a powerful cause of multiplication.

There is then a distinct organic form, which may be considered as a primary act of individualization, or a primary manifestation of life, between the amorphous state of this matter and its actual application to the formation of the cellular walls. This primary act, or this primary manifestation, has for its object the formation of granular spheres, which, without being bounded by an enveloping membrane, have already a true existence, are true living individuals, inasmuch as they enjoy the faculty of reproduction, and in multiplying they become the active elements of the organism, and contribute to the formation of the tissues of which the organism is composed.

For my own part, I am unacquainted with anything which is more curious to observe than this progressive duplication of living spheres, reproducing in each secondary segment the reduced but invariable image of the primary vitelline sphere. And in proportion as we witness the realization of this remarkable phenomenon, we are as it were involuntary led to seek, in the material of the substance which is doubled, some arrangement which may explain a metamorphosis, the cause of which cannot be clearly found elsewhere.

In fact, a more attentive examination soon shows that in the centre of each vitelline sphere there exists a diaphanous homogeneous globule having a fatty aspect, and which cannot be compared to anything better than a drop of oil. Seeing that this globe appears in so constant a manner, we inquire if the division of the *vitellus* cannot be attributed to its influence. But in order to solve this problem, what passes in this same vitellus prior to its division, and when it consequently appears as a simple sphere, should be examined.

We then see that the fatty or oleaginous globe, hidden in the midst of the granulations of the primitive sphere, there undergoes a contrac-

tion which divides it into two segments or distinct globules, and each of these segments seems to become a centre, which tends to envelope itself in a portion of the surrounding granulations, separating them from cells which are entangled by its fellow. We should say, in short, that the vitelline sphere, excited simultaneously by two centres of action, yields to each of these centres half the substance of which it is composed, and thus divides into two segments which are immediately rendered spherical; each segment of the vitelline sphere, being furnished with the oleaginous globule which has excited the separation, then becomes in its turn the seat of a similar process, and the division of its central globule induces that of the secondary sphere which contains it. This is the manner in which the phenomenon of the multiplication of the vitelline spheres ensues; but this phenomenon, which we have considered as the result of a double influence simultaneously exerted upon each of the segments of the *vitellus* by the division of the fatty globe which occupies its centre,—this phenomenon, I say, seems to refer to a still deeper cause, and so to speak, to be nothing more than the external and consecutive repetition of a more intimate and previously completed process. In fact, each central fatty globule contains in its interior a much smaller generating globule, and which appears, in regard to the fatty globule, to play the same part as the fatty globe fulfils with regard to the vitelline spheres by which it is enveloped. So that if we review the whole of the facts which the *vitellus* presents during the transformations which we have described, we find that the elements to which these metamorphoses give rise are derived from one another in a continued series, and are all the result of a triple envelopment.

This envelopment commences by the appearance of a primordial globule within the vitelline spheres; the globule then becomes a centre, around which the fatty globule is condensed; the latter subsequently resolves itself into two distinct fragments; and these fragments, enveloping themselves with the vitelline matter, produce the granular spheres, the mode of multiplication of which I have previously described.

The formation of the organic spheres by successive envelopment around a centre, and their multiplication by subdivision, are such general facts as to require the whole attention of physiologists. They are observed in the *vitellus* of Mammalia, Batrachia, the osseous fishes, Mollusca, insects and worms. The so frequent production of these particular forms of matter proves, in opposition to the opinion of Schleiden and Schwann, that organized bodies are not exclusively composed of cells; but that other elements may also enter into the composition of their tissues, and that the organic spheres ought to be reckoned among these elements. They do not in fact appear only as a transitory

modification of the vitelline matter undergoing the primary influences of fecundation, for they are also found in tissues which are undergoing development, and even in those which form a part of the adult organism. It is these which, by their juxtaposition in the Mammalia, give origin to the earliest and most important formation of the tissues of the germ, because the blastodermic membrane is formed at their expense; that is to say, that which will subsequently become the basis of the entire organism. It is true that by gradual conversion into cells they soon raise the blastodermic membrane to a higher degree of organization; but they reproduce it at a period when they are still simple granular spheres, and they then still enjoy all the properties of these spheres, so that after their incorporation they continue for a certain time to multiply by subdivision, as we shall show in a future memoir.

2. *Spondylosaurus;* by M. Fischer de Waldheim, (Bull. Soc. Imp. Nat. de Moscow, tom. viii, 1845; L'Institut, No. 624, Dec. 1845.)—The fossil to which the name Spondylosaurus has been given, was found by M. H. Frears, near Stchioukino, on the banks of the Moskwa, in the Oolite formation. Only a few vertebræ have been seen. The form and size of the vertebræ appear to place the animal between the Plesiosaurus and Ichthyosaurus. Their form is round, a little ovoid transversely. The anterior surface is concave and smooth; the posterior a little less concave. They are rather broader than long, and nearly cylindrical, with the middle a little smaller than the ends. There are only two apophyses, dorsal and costal. A process extends from these apophyses and unites with the transverse apophyses. The latter are situated exactly at the middle of the vertebræ and have a funnel shape; the rib must therefore have had a rounded head, and articulated freely in this cavity, with a ligament attached to the process just mentioned. The name of this species alludes to this peculiarity. The specific name given to it, is *Spondylosaurus Frearsii.*

3. *Thoracoceras, a new genus of the family of Orthoceratites;* by M. Fischer de Waldheim, (L'Institut, No. 631, Feb. 4, 1846, p. 48.)—The genus Thoracoceras is distinguished by having the transverse septa concave, imbricate or distant, and not surrounding entirely the siphuncle. The siphuncle is always marginal, sometimes thin, or appearing obliterated at the junction with the septa, and sometimes remarkably thick; and it may be either spirally contorted or annulated, or covered with scales or leaves. [This genus appears to be identical with Conrad's Cameroceras, instituted in 1842.—*Jour. Acad. Nat. Sci.* viii, 267.]

4. *Fins of Fishes afford important characteristics.*—Prof. Agassiz observes as a result of some late investigations, that the characters drawn from the fins of fishes, hitherto almost entirely neglected, are highly important to Zoology and Palæontology.

5. *Two species of Fossil Asterias in the Blue Limestone of Cincinnati;* by Messrs. G. Graham, J. G. Anthony, and W. P. James, (from the report of a Committee of the Western Academy of Natural Science, communicated by the Academy to this Journal.)—The largest of the two specimens, belonging to Mr. W. P. James, appears to be a true Asterias as the genus is at present constituted, having all the characters of that genus, so far as the examination of one side only enables us to judge. The specimen is in a very perfect state of preservation, having the rays nearly entire, and the spiny projections surrounding the mouth beautifully exhibited. The size of the fossil is that of the A. aurantiaca, of the British coast, being about 4 inches across.*

The smaller specimen, discovered by Mr. Robert Clark, we find to belong also to the Echinodermata, but to a different genus, the "Goniaster of Agassiz," commonly called the "cushion star," from the gibbous appearance of its upper surface. This specimen is very small, measuring not quite $\frac{3}{8}$ of an inch from one extreme point to the opposite. Its outline is perfect, but it presents only its upper surface.

We regard the discovery of these two specimens of Echinodermata with peculiar interest. For a long time the Crinoidea were supposed to be the only representatives of Echinoderms in the blue limestone around our city. Subsequently the discovery of numerous remains of

* The figure here given is reduced about one sixth lineally.

Agelocrinites in our strata, contributed a new member to the family; and now by the discovery of these interesting specimens, we are enabled to add two other genera, species of which have rarely been found in deposits anterior to the chalk.

The locality where these remains were found, is about one mile north of the city, near the Vine-street road, and about 300 feet above low water mark of the Ohio river. Near this spot have been found hundreds of very perfect Encrinites, having in many cases the column attached to the head; and also in the same vicinity occur fine specimens of Agelocrinites, rendering this locality a favorite one to the collector of fossil remains.

Cincinnati, March 30, 1846.

6. *Circulating fluid in the Planorbis imbricatus*, (L'Institut, No. 627, Jan. 1846, p. 4.)—M. Quatrefages has observed that in the Planorbis imbricatus, common in the fresh waters of the vicinity of Paris, the blood has the red color of the lees of wine. When but little magnified, the circulating fluid may be seen filling the cavities of the pericardium and ventricle, and at short intervals to color quite distinctly the general cavity of the body throughout its inferior surface.

7. *Siliceous shields of Infusoria from Guano.*—The guano from Ichaboe, when long digested in acids, leaves a siliceous residue, which, examined under the microscope, with a power magnifying from 200 to 400 linear, is found to consist entirely of the shields of Coscinodisca, Actinocyclas, &c. &c., of the most exquisite forms, and presenting the most beautiful play of colors.

8. *Zoological Researches.*

Annals and Magazine of Natural History, February, 1846, No. 108, vol. xvi.—An index to the British Annelides, (a full catalogue with synonyms and references,) by George Johnston. *February*, No. 110, vol. xvii.—Spiders of Canada, (continued,) J. Blackwall.—Notice of some birds from Western Africa, Sir W. Jardine.—Economy of the Paussidæ, W. J. E. Boyes.—Some undescribed Chalcidites, F. Walker.—Zoological Society, July 22, 1845; three new birds from Australia, Mr. Gould.—Aug. 12; new species of Murex, L. Reeve.—Aug. 26; on the genus Achatinella, L. Pfeiffer. *March*, No. 111.—Hyperoodon Butzkopp, with a figure, W. Thompson.—Caprolagus, a new genus of Leporine Mammalia, E. Blythe.—Some undescribed Chalcidites, (continued,) F. Walker.

Académie des Sciences de Paris, Dec. 8, 1845.—Development of the Medusæ and the Hydra Polyps, M. Dujardin. *Feb.* 2, 1846.—Report on M. Lereboullt's Monograph on the Onisci of Alsace, with details of structure; by Milne Edwards. *Jan.* 5, 1846.—Anatomy of the Gastrochenia dubia, of the Mediterranean, M. Deshayes.

Société Philomatique de Paris, Jan. 17, 1846.—On the embryogeny of the Diptera of the tribe Ornithomyiens, (Pupipara of Lamarck,) M. Emile Blanchard.

Kongl. Vet. Akad. Handlingar, for the year 1843.—Monograph of the Swedish Ephydrinæ, by C. Stenhammar.—On the wings of Birds, C. J. Sundevall.—Myodes schisticolor and Sorex pygmæus, new Scandinavian mice, M. Silljeborg.

IV. Astronomy.

1. *The new planet Astræa.*—In our last number we briefly noticed the discovery of a new planet. Having lately received much fuller intelligence respecting it, through the Astronomische Nachrichten, we proceed to lay it before our readers, regarding this as marking an epoch in the history of astronomy. The following is the letter of M. Hencke of Driesen to Prof. Schumacher, announcing his discovery.

Driesen, Dec. 10, 1845.

Having been employed day before yesterday in observations on the planet Vesta, on account of its great brilliancy at the present time, I examined attentively the stars in its vicinity and found one of the ninth magnitude which I had not seen before, not being found upon my chart, which contains many stars of the 9–10th magnitude, and all the brighter ones. Neither could I find it on the chart of the Academy, although Prof. Knorre bestowed extraordinary attention upon this region, and has included almost all the stars up to the 9–10th magnitude. The place of this stranger, reduced to the equinox of 1800, was in A. R. 64° 47′·5, and Dec. 12° 34′·7 N., Dec. 8th, at 8h.: lying between two stars of the 9–10th magnitude which are found on the chart of the Academy. Unfavorable weather prevented my searching for it yesterday, and probably will continue for some time to come; this notice is therefore for those who being favored with better weather are able and disposed to follow this stranger. It is very improbable that this should prove to be merely a variable star, since in my former observations of this region, which have been continued for many years, I have never detected the slightest trace of it. K. Hencke.

The supposed discovery of a new planet was first verified at Berlin. The following is the letter of Prof. Encke to Prof. Schumacher.

Berlin, Dec. 15, 1845.

I think I am now able to announce to you a new planet. On the 13th of Dec. it was stated in Voss's Gazette that M. Hencke of Driesen, whom since the formation of our new charts of the stars I have known as a zealous amateur of practical astronomy, and who since that time has made for himself special charts of particular districts, had seen a new star of the ninth magnitude. Its place referred to the present equinox, was in A. R. 65° 25′, Dec. 12° 41′. Yesterday we searched in this region with the refractor, and found a star of the ninth magnitude, not given on the chart of the Academy, which we compared by means of the circular micrometer with a star of the Histoire Céleste, and found the following differences of R. A.:—$6^h\ 28^m$ m. t. $+49^s{\cdot}81$ in time.;—$12^h\ 43^m$ m. t. $+34^s{\cdot}95$.

Hereupon we introduced the filar micrometer, and from a mean of 15 observations obtained the following place. Dec. 14, $13^h\ 56^m\ 59^s{\cdot}7$,

m. Ber. t., A. R. 64° 0′ 23″·6, Dec. 12° 39′ 53″·1. The star is retrograding like a planet near its opposition. ENCKE.

The new planet was observed at Altona and Hamburg on the 17th; at London and Cambridge on the 24th; at Pulkova on the 26th; at Bonn, Jan. 2d; and from this time it was followed at nearly all the observatories of Europe. The following are the observations made at Berlin, as far as they have been received.

	h. m. s.	° ′ ″	° ′ ″
Dec. 14	13 56 59·7, m. t.	A. R. 64 0 36.0	Dec. +12 39 49·6
15	7 12 9·3	63 50 54·1	12 40 0·5
16	10 20 16·5	63 36 5·6	12 39 57.1
20	7 38 51·2	62 48 6·4	12 41 31·5
21	7 49 38·4	62 36 27·0	12 42 16·9
27	11 29 14·6	61 33 46·4	12 49 51·8
31	8 0 18·9	61 2 57·3	12 57 17·3
Jan. 3	8 14 33·7	60 43 37·2	13 4 23·4
6	6 31 24·9	60 29 12·9	13 12 21·3

At Hamburg, on the 15th of January, $8^h\ 54^m\ 3^s{\cdot}1$, its place was in A. R. 60° 11′ 57″·5, Dec. 13° 43′ 58″·3.

The following are Prof. Encke's elements, deduced from his observations of the 14th, 21st and 27th.

Epoch of mean longitude, 1846, Jan. 0,	94° 48′ 11″·8	
Mean anomaly,	319° 2′ 54″·8	
Longitude of perihelion,	135° 45′ 17″·0	Mean equinox,
Longitude of ascending node,	141° 10′ 6″·7	1846, Jan. 0.
Inclination,	5° 20′ 7″·2	
Eccentricity,	0·195520	
Semi major axis,	2·59158	
Mean motion,	850″·473	
Period,	1524 days.	

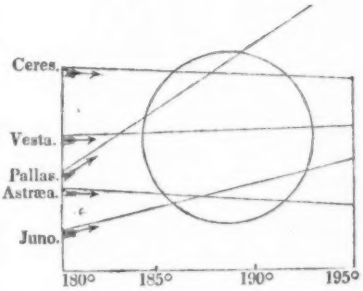
The following places were computed from these elements.

Feb.	1, 8^h m. B. t.,	A. R. 61° 28′ 49″,	Dec. 15° 3′ 47″ N.
	18,	64 55 48	16 39 31
March	6,	69 47 35	18 11 41
	22,	75 54 8	19 35 19
April	7,	82 59 30	20 41 52
	23,	90 49 30	21 24 31

The following comparison shows conclusively that Astræa belongs to the family of the asteroids.

	Node.	Inclination.	Eccentricity.	Period.	Distance.
Vesta,	103°	7°	0·088	1335	2·373
Astræa,	141	5	0·195	1524	2.592
Juno,	170	13	0·254	1591	2.667
Ceres,	81	11	0·079	1682	2.767
Pallas,	172	34	0·240	1682	2.768

The opinion has been often expressed that the asteroids are the fragments of a large body which once existed between Mars and Jupiter. This opinion has lost none of its plausibility by the discovery of Astræa. Indeed in the position of its node, in its period and eccentricity, this planet conforms very nearly to the mean of the elements of the four former planets. It was remarked by Dr. Olbers that according to the above hypothesis, since the orbits must all have diverged from the same point, so they must have two common points of reunion in opposite parts of the heavens. The following diagram will show how nearly this conclusion conforms to observation.



This diagram represents a portion of the orbits of the asteroids as seen from the sun, corresponding to a heliocentric longitude of 180° to 195°, and the circle which is added has a radius of four degrees. We perceive then that a circle of four degrees radius embraces at least five degrees of the orbit of each of the Asteroids, *Astræa included.* We see also that if this small circle had been faithfully watched for four years, these five planets must all have been discovered. This is precisely what Olbers undertook to do, and his search was rewarded by the discovery of Vesta. With such perseverance did he maintain the watch, that he announced that no new planet could have passed between 1808 and 1816. In this he was certainly mistaken; Astræa glided by him unperceived.

In may be thought that the above theory requires that the orbits should all pass, not *almost*, but *exactly* through the same point. The answer to this objection is, that the orbits are disturbed by the attraction of the other planets, and that we may readily admit that at no very distant period, the orbits *did* all pass through a common point.

It may be interesting to compare the dates of all those planets, the period of whose discovery is known. They are as follows:—

Uranus,	March 13, 1781,	by Herschel.
Ceres,	Jan. 1, 1801,	Piazzi.
Pallas,	March 28, 1802,	Olbers.
Juno,	Sept. 1, 1804,	Harding.
Vesta,	March 29, 1807,	Olbers.
Astræa,	Dec. 8, 1845,	Hencke.

This last discovery may perhaps excite astronomers to set a new watch, to intercept any other planets which may presume to venture upon this field of a former catastrophe.

2. *Biela's Comet.*—In our last number, we gave a short notice of the discovery of this comet. It was seen at Rome by M. De Vico, on the 26th of November, the earliest observation of which we have received any account. It was observed at the same place, Nov. 28th, 29th, and Dec. 1st.

The comet was seen at Berlin for the first time, Nov. 28th, and again on the 29th, but so faint that Prof. Encke could with difficulty satisfy himself of its existence. Its place differed about six minutes of arc from the ephemeris of Santini, a coincidence quite satisfactory, considering that the comet had not been seen for fourteen years.

The comet was seen at Cambridge, Eng., on the 1st of December, and again on the 3d. It was observed at London by Mr. Hind, December 19th and 20th; and on the 21st, Dr. Galle, at Berlin, was able to observe it with illuminated lines.

On the 2nd of January, M. Struve writes from Pulkova, that he had not been able to see the comet, and on account of its small elevation above the horizon, had given it up entirely for this return.

The most remarkable circumstance attending this return of Biela's comet, is that it has been attended by a companion like a secondary comet. This secondary comet has been remarkable for its changes of brilliancy and of distance from Biela. On the 29th of December,* the companion was merely a faint nebulous spot, barely distinguishable; but from this time it increased in brightness faster than Biela. On the 13th of January, it was estimated to have one fourth the intensity of Biela, and one eighth the magnitude. On the 16th of February, it was estimated to be equal to Biela as to magnitude, and to have one third more intensity. Two days afterwards, Biela was estimated to exceed

* According to observations made at this date by Messrs. Bradley and Herrick at Yale College, with the refractor of five inches aperture, the angle of position of the line joining the main comet and its companion (the latter being then a dim nebulous spot N. preceding, and causing the appearance of a tail in that direction) was then about 310°, reckoning N. *f.* S. This angle was obtained by means of independent diagrams of the field of view by each, which gave results differing but five degrees. It is of course liable to considerable error. The moon at this time was absent, and the sky very favorable for observation.

On the nights of March 30 and 31, an attempt was made by the same observers to ascertain the distance between the comet and its companion. The latter was barely within the limit of visibility, and could be detected only by occasional glimpses. By means of a diagram of the field, the angular distance of the centres of the two bodies was estimated to be sixteen minutes of arc.

By the middle of April, the comet (Biela) had become very faint. Mr. Bradley determined its place (mean of two measures by the ring micrometer with star 62 of Bessel's zone 231, and two with star 64 of the same) at 11*h*. 3*m*. sid. t. N. H., Apr. 16, to be 53*s*. preceding, and 1′ 50″ South of the latter star, the registered place of which is R. A. 9*h*. 7*m*. 59.22*s*.; S. dec. 12° 22′ 9″.

its companion at least twofold, both in quantity and intensity of its light. From this time the companion dwindled away most rapidly, and by the fore part of March, it was so faint as to be very difficult of measurement, although Biela continued in good view.

This companion was perhaps equally remarkable for its changes of distance from Biela. The 1st of January its distance was about one minute of space. Jan. 14th, the distance was 1′·6; Feb. 18, distance 5′·8. The distance of the comet from the earth Jan. 14th, was ·790; Feb. 18, ·502; so that if we suppose the line joining the two bodies to have been constantly presented to us at the same inclination, their absolute distance from each other must have more than doubled in one month. Prof. Challis, of Cambridge, Eng., noticed this phenomenon for the first time, Jan. 23, and has furnished the following table of relative positions.

	Mean time.	Difference of A. R	Difference of Dec.	Angle of position.	Distance.
	h.	s.	″	° ′	″
Jan. 23, . . .	7·1	5·18	122·9	327 43	145·4
" 24, . . .	7·0	5·11	126·6	328 48	148·0
" 27, . . .	6·4	5·84	144·6	328 48	169·1
" 28, . . .	6·3	5·77	151·1	330 12	174·1
" 29, . . .	7·4	5·44	154·4	332 10	174·6
Feb. 11, . . .	7·4	7·38	249·7	336 8	273·1
" 12, . . .	7·1	7·86	252·7	335 3	278·7
" 13, . . .	7·5	8·30	264·9	334 51	292·6

3. *The Bond Comet.*—A new telescopic comet was discovered by Geo. P. Bond, of the Cambridge (Mass.) Observatory, on the evening of February 26, 1846. The following parabolic elements of the comet were obtained by Mr. Bond, from observations thereto annexed taken at that observatory, and referred to the mean equinox of January 1, 1846.

Perihelion passage,	Mch. 5.5376 Greenw. m. s. t.
Perihelion distance,	0·6673
Longitude of perihelion,	89° 51′ 15″
" " asc. node,	76° 59′ 29″
Inclination,	84° 46′ 32″
Motion,	direct.

1846. Camb. m. s. t.		
Feb. 26.3415.	A. R. 1h 0m 25·7s	N. Dec. 3° 19′ 17″
Mch. 1.3164.	" 1h 0m 32·9s	" " 8° 8′ 35″
" 4.3215.	" 1h 0m 1·5s	" " 12° 46′ 5″

The subjoined set of parabolic elements was obtained from observations made by Mr. Francis Bradley, at the Yale College Observatory.

Perihelion passage,	March 5.0019	Greenw. m. t.
Distance,	0.6673	
Longitude of perihelion,	88° 44′ 39″	
" asc. node,	77° 16′ 32″	
Inclination,	84° 46′ 33″	
Motion,	direct.	

The following are the observed places, referred, without correction, to the mean equinox of Jan. 0. 1846.

			h.	m.	s.		°	′	″		°	′	″
1846. Mch. 5.	Sid. t.	N. H.	6	25	0	R. A.	14	56	4·34	N. Dec.	14	14	44·34
9.	"		7	11	13	"	14	25	30·37	"	19	51	58·31
19.	"		7	22	33	"	12	20	33·62	"	31	42	48·16

Prof. Benjamin Peirce, of Harvard University, has published the following communication relative to the comet, in the Boston Courier, under date of March 26, 1846.

"Having been unable to satisfy the observations made by Mr. Wm. C. Bond, the director of the observatory, upon the comet discovered by his son Feb. 26, by any parabolic orbit which I could obtain, I have applied the general method of computation to the observations of Feb. 26, March 9, and 18. I have obtained the following orbit, having a period of revolution of 95 years, which completely satisfies the observations of Feb. 26, and March 1, 2, 3, 4, 6, 9, 10, 11, 12, 17, 18, 21. The period of revolution cannot be relied upon as accurate within several years, but if the comet should be visible as late as June or July, I think it may be determined within a year. There seems a reasonable expectation that it will be seen at that time, and I hope the telescope of $4\frac{1}{2}$ inches aperture just received at the observatory, from Simms, of London, will enable Mr. Bond to take observations upon it.

Perihelion passage,	March 5.49947	Gr. m. s. t.
" distance,	0.664316	
Mean dist. from sun,	20.80761	
Eccentricity,	0.9680734	
Period,	94.9147	years.
Inclination,	85° 11′ 29″·5	
Long. of asc. node,	77° 29′ 47″·5	Mean equin.
" perihelion,	90° 16′ 19″·2	Jan. 1, 1846.
Motion,	direct.	

"The small difference in the elements between this orbit and Mr. Geo. P. Pond's parabola, arises almost wholly from the introduction of the period of revolution as an element of calculation."

4. *First Comet of* 1846, (N. Y. Jour. of Com., Mch. 25, from Lond. Times, Feb. 12.)—M. De Vico, at Rome, discovered a comet in the constellation *Eridanus*, January 24, 1846. At $10^h\ 38^m\ 17^s{\cdot}8$ m. t.

Rome, its R. A. was $4^h\ 6^m\ 59^s{\cdot}2$, and S. Dec. $7°\ 11'\ 30''{\cdot}6$. Its hourly motion was $1^s{\cdot}434$ to the East, and $2'\ 56''$ to the North.

5. *Comet of* 1844–45; by J. C. Haile, Esq., (Athenæum, No. 956, 1846, p. 201.)—Mr. Haile has presented to the Royal Society a series of observations on the comet of 1844–45, accompanied by a diagram, made by him at Auckland, New Zealand. The comet appeared on the 20th of December, 1844, and is said to have disappeared on the 30th of January following. Its most remarkable feature was, that during its greatest brilliancy, the nucleus was not surrounded by the nebulous matter, but was situated at the very extremity of the head, and at times appeared quite detached. (See farther, *Southern Comet of December*, vol. xlviii, p. 402, of this Journal.)

6. *Planet Saturn.*—Sir John Herschel states as a fact obvious enough, but not before noticed, that the periodic time of the first satellite of Saturn (first in order of the ring) is *precisely half* that of the third, and the periodic time of the second *precisely half* that of the fourth.

V. Miscellaneous Intelligence.

1. *Anastatic Printing.*—We have before noticed this important improvement (American Jour. Sci., vol. xlix, p. 401) in the art of printing, by means of which printed or written documents may be multiplied in fac-simile to any extent, by a process similar to that by which lithographic printing is done; a metallic plate (zinc) being used in place of the stone. We take pleasure in laying before our readers a specimen of this art in the annexed pages, from the narrative of Capt. Wilkes, copied by the anastatic press of Mr. Robt. P. Smith, (who is agent for the American patentees,) 144 Chesnut-st., Philadelphia. As we have before described the process, it is unnecessary to repeat it here. We have before us numerous other specimens of the art as practised by Mr. Smith; pages from scientific books, illustrations from the London Times, copies of manuscripts, maps, music, autographs, and handbills, many of which are done with great beauty and clearness. The printing, like the lithographic, is slow and expensive, compared with the rapid motions of the power press. The art may however be considered in its infancy, and great improvements may be looked for, which will extend its applications and cheapen its cost. In its present state, however, it has a wide and most useful application. The cost of a *single* page like one of those opposite, is now about $10, including the paper and press-work for 1400 copies; the same work in common type and printing, would cost about $4. It will be seen that this is far less, however, than the art of lithography.

2. *Electro-culture*, (Jameson's Journal, Jan. 1846, p. 153.)—Dr. Fyfe concludes from an extensive series of experiments on the application of

electricity to the growth of vegetation, that no benefit whatever has accrued from the different processes followed. He does not assert, however, that electricity can be of no avail in promoting vegetation, though doubting strongly its use. The further prosecution of the subject by trials on an extended scale is recommended.

3. *On the death and disappearance of some trees and shrubs;* in a letter from W. Jones, dated Riceboro, Georgia.—The present remarks are particularly directed to the death and disappearance of some of our trees and shrubs. The first that I will mention is the Castanea pumila, which is a tree from 10 to 30 feet in height. In the year 1825, during the months from June to September, I observed this tree dying when in full leaf and with fruit half matured. I examined numerous individuals and could find no internal cause of their dying. I at first attributed it to the great fall of rain which took place in the year 1823; for during the month of July of that year, a considerable quantity of land not subject to overflow was covered with water for some time, and the highest lands were completely saturated. The latter part of 1824 was also very rainy. Knowing that this tree belonged in our highest and driest soils, I concluded that it was owing to a too moist state of the ground. But since that time I am convinced there must be some other cause; for the tree continues still to die, up to the year 1845, and if the disease is not arrested, in a few years I fear it will be entirely exterminated.

In the year 1826 I discovered also that the Laurus geniculata showed the same signs of dying, and many died in the course of that year. The Laurus geniculata in the southern part of Georgia formed beautiful round groves in the pine barrens. From one spot I have viewed three or four of these round ponds (as they are called by the inhabitants) through the tall Pinus palustris, which tree forms the forest of these barrens; and contrasts with the Laurus in its deep green foliage as well as size. At this time, these once beautiful spots amid the pine forest are all exterminated; and I have not seen a single individual alive within the last five years. The Gordonia lisianthus, a very beautiful tree which once abounded in this region, has almost entirely disappeared from some localities. I have known whole forests of these trees, for miles in extent, (where they formed bays or branches,) to die in the course of two or three years, leaving not a single individual to mark the spot where they once grew. The Quercus rubra also for the last six years has been going in the same way. I have noticed this tree in situations favorable to its growth, to put out its leaves in the spring, grow very little and appear sickly during the summer months, and the next spring put out again and then suddenly die. I have observed a few in-

dividuals of the Laurus sassafras also dying. I have no where seen any account of a similar death among the trees of our forests, and it is to be hoped that some one may give the subject their consideration and assign the cause.

4. Prof. Louis Agassiz *of Neufchatel, Switzerland.*—This distinguished naturalist, who is known wherever science is cultivated, is about to visit the United States. His intention has been, for some time, privately announced by him to his scientific friends in this country, and we are now assured by a recent letter from himself, that leaving Neufchatel in February, he would spend some weeks in Paris, before passing to London, but that he would not leave England for America before April; probably we may expect his arrival at New York or Boston in the course of the month of May.

He enjoyed the friendship and confidence of Cuvier, who committed to him the charge of carrying forward the Natural History of Fishes, which Cuvier had begun. His great work on fossil fishes is finished, except that new discoveries will, from time to time, demand its extension. His publications on the Echinodermata are far advanced; we have splendid examples of the work on modern fishes, and his study of the glaciers of Switzerland and the vicinal Alps formed an episode in the midst of his labors in various departments of natural history. All his works are illustrated by numerous figures and drawings, distinguished alike for accuracy and beauty. Having been favored by the author from time to time, by receiving the results of his numerous and arduous labors, they have been mentioned in various numbers of our first series. Prof. Agassiz, by the friendship and advice of Alex. von Humboldt, enjoys the *substantial* patronage of the king of Prussia, and will pass two years in the United States, aided by a taxidermist or preparer of specimens in natural history, and by a draftsman to copy the various objects, especially fishes and molluscous animals, and the corresponding fossil families will of course be included. His devotion, ability, and zeal—his high and deserved reputation, and (as we are assured from unquestionable sources) his amiable and conciliating character, will, without doubt, secure for him the cordial coöperation of our naturalists, and the favor of the public wherever he may travel over our vast territory. We recommend him and his cause to all lovers of science and of mankind. He is strongly impressed by the activity and success of our own naturalists, (although few of them are able to cultivate science exclusively,) and he is most anxious to form their personal acquaintance and to obtain their assistance. We have no doubt that as a powerful auxiliary and fellow laborer in a common cause, he will be every where received with cordiality, and seconded by efficient aid; nor do we en-

tertain a doubt that we shall be liberally repaid by his able review and exploration of our country.

5. *Lake Torrens, South Australia;* (Athenæum, No. 955, Feb. 1846.)—Much has been written about Lake Torrens, which Mr. Eyre first stated to exist to the north of Spencer Gulf in South Australia, near latitude 30° and longitude 139° or 140°. Ascending an elevation, it appeared to him to stretch away to the northeast as far as the eye could reach, apparently about 30 miles broad, and seeming to be bounded on its western shores by a low ridge or table land, beyond which nothing could be seen. In 1843, Captain Frome visiting the region, found the lake to be only a semblance of one due to mirage, and its islands low sandy ridges. A salt crust was seen at intervals on the surface of the sand at the margin of the lake, or, as it would be more properly styled, the desert. The same region was visited by Mr. Poole in 1845, who encamped on the eastern margin of the lake in longitude 141° 40′, and latitude 29° 40′. He found a sandy desert, and only some pools of water, forming a succession of lakes, produced by the drainage of the hills. He remarks, however, "that the country on approaching Lake Torrens is so peculiar that any one looking down upon it from such lofty eminences as Mount Serle and Mount Hopeless would naturally conclude that the whole was the large bed of a lake."

6. *Infusoria in Guano.*—In connection with the statement on page 442, from an English source, reference may be made to J. W. Bailey's observations, Vol. xlviii, p. 338, of this Journal.

7. *The Collection of Fossils of Herr Munster of Bayreuth* has been purchased by the government of Bavaria. According to the Munich accounts it consists of 150,000 specimens and is one of the richest in existence. The greater part of the specimens are from the rocks of Bavaria and the adjoining countries.

8. *Height of Vesuvius;* (L'Institut, No. 628, Jan. 1846, p. 10.)—M. Pentland makes the height of the highest point of Vesuvius, above the sea, (la Punta del Palo,) 1203¼ metres, or 3864½ feet. It is stated that this point has not varied its altitude for many years.

9. *Italian Congress of Science.*—The eighth scientific congress of Italians will be held at Genoa in the beginning of May, and preparations are said to be made to give the Savans a hospitable reception.

10. The Queen has conferred the honor of Knighthood upon Roderick Impey Murchison, F. R. S. This distinguished geologist has also been knighted by the Russian emperor, being made a knight of the first class of the Imperial Russian Order of St. Stanislaus.

The honor of Knighthood has also been conferred upon Dr. John Richardson, F. R. S., the celebrated Polar traveller, and medical inspector of hospitals and fleets.

Bibliography.

1. *Annals of the Lyceum of Natural History, of New York.*—No. 5, of vol. iv. of the Annals is just issued. The following is a list of its memoirs:

Monograph of the species of Pasimachus inhabiting the United States, with descriptions of two new genera belonging to the family Carabica, by J. L. LeConte, p. 141, with figures.

A new species of Apus (A. longicaudatus) by J. Le Conte, p. 155, with a figure.

Three new fossils from the Falls of the Ohio, by J. Cozzens, (Piliolites Ohioensis, a new genus and species of Crustacea, Pentagonia Peersii, Conulites elevata,) p. 157, with figures.

On certain Coleoptera indigenous to the Eastern and Western Continents, J. L. Le Conte, p. 159.

Descriptions of some new species of shells. J. H Redfield, p. 163, with figures.

Description of some new shells, by J. C. Jay, p. 169, with figures.

The officers of the Lyceum for the year 1846, are as follows:

President, Major Joseph Delafield. *1st Vice President*, John Augustine Smith, M. D. *2d Vice President*, Abraham Halsey. *Corresp. Secretary*, John H. Redfield. *Recording Secretary*, Robert H. Browne. *Treasurer*, Jacob P. Giraud, jr. *Librarian*, Robert H. Browne. *Publishing Committee*, Major John Leconte, Abraham Halsey, William C. Redfield, Jacob P. Giraud, Jr., William A. Seely.

2. *Transactions of the American Philosophical Society, Philadelphia*, vol. ix, part 2.

On two storms in the United States, February, 1842. Elias Loomis.

On the conversion of benzoic into hippuric acid, J. C. Booth and M. H. Boyé.

Account of the observatory and instruments of the United States Military Academy at West Point; with observations on the Comet of 1843, by W. H. C. Bartlett.

Character and prospects of the Copper region of Gibara, and a sketch of the geology of the northeast part of the Island of Cuba, by R. C. Taylor.

Notice of fossil arborescent ferns of the family of Sigillaria and other coal plants, exhibited in the roof and floor of a coal seam in Dauphin County, Penn., by R. C. Taylor.

Description of some new fossil shells, from the tertiary of St. Petersburg, Virg., by H. C. Lea.

3. *American Academy of Arts and Sciences, Boston.*—A volume of the transactions of this society, will appear in the course of the month of May. We are informed that the printing of the next volume will proceed without interruption; it will be published in half volumes or smaller parts.

4. *Bibliothèque Universelle, Geneva.*—A supplementary monthly Journal, of 100 pages, has been added to the Bibliothèque Universelle, entitled *Archives des Sciences Physiques et Naturelles.* The first

number was to appear in February last. It is under the editorship of MM. de la Rive, Marignac, and Pictet. Price 30 fr. per year; or 55 fr. in connection with the other branch of the Bibliothèque Universelle.

5. "*Phycologia Britannica: or History of the British Sea-Weeds*, containing colored figures, generic and specific characters, synonymes and descriptions of all the species of Algæ inhabiting the shores of the British Islands, by William Henry Harvey, M. D., M. R. I. A., Keeper of the Herbarium of the University of Dublin. Roy. 8vo.; to be completed in sixty monthly parts, each containing six colored plates, with descriptive text; price 2*s.* 6*d.*; large paper, 5*s.*"

We have not seen this work, but the name of Mr. Harvey, the accomplished author of the *Manual of British Algæ*, affords the highest guaranty of its accuracy and value. A. Gr.

6. *Hooker's Species Filicum*, etc.—The third part of this work, which has just reached us, is principally occupied with the genus *Davalia*, (pp. 129–142, plates 40 to 60 inclusive.) The *Botany of the Niger Expedition*, by Sir Wm. and Dr. J. D. Hooker is announced, to which a biography of Mr. Vogel, the naturalist, who perished in that ill-starred enterprise, is to be appended. A. Gr.

7. Hassall, *History of the British Fresh-Water Algæ, including descriptions of the Desmideæ and Diatomaceæ*, 1 vol. 8vo. of text, with an accompanying volume of plates (100 in number,) colored after nature. This work will prove a very needful help to the student of these minute and hitherto most obscure tribes, although in some particulars, —not however affecting the general value of the work,—Mr. Hassall has been quite severely criticised in some of the English Journals.

8. Martius, *Palmarum Genera et Species.*—We are informed that the 8th part of this magnificent work is on the eve of publication. Indeed it has probably appeared at Munich before this, and the remainder of the work is promised in August or September, so that this great undertaking will probably be brought to a conclusion in the course of the present year. A. Gr.

9. Ledebour, *Flora Rossica.*—The 6th part of this work (part 2nd of vol. 2) was published during the past year. It is occupied with the *Compositæ*, of which it includes nearly all the *Tubulifloræ*. *Illustrations of the Russian Flora by Dr.* Trautvetter, (*Plantarum imagines et descriptiones floram Rossicam illustrantes,*) are in the course of publication, but no part of the work has yet reached us. A. Gr.

10. Boissier, *Voyage Botanique dans le Midi de l'Espagne;* Paris, 1839–1845, 2 vols. roy. 4to.—The first volume of this beautiful work is occupied with the narrative of M. Boissier's tour,—which is full of interest,—with a treatise on the Geographical Botany of Granada, and with the plates of the systematic part of the work, over 200 in number.

which are finely engraved from drawings by Heyland and are half-colored. The second volume consists of a complete enumeration of the plants of the old kingdom of Granada, so far as yet known; and the large number of new species here described, affords an indication of the rich harvest which the author has gathered in a region which, it appears, had been less explored by botanists than any other part of Europe.

11. *Botany of Mexico.*—The largest collection of Mexican plants ever made, is that recently brought by M. Liebmann, to Copenhagen. It is said to amount to 8000 species. The collection is to be published, in the finest style, at the expense of the Danish government. The first volume, now in press, will contain the Palms. The study of the Coniferæ is committed to Prof. Zuccarini, of Munich, who has recently so ably illustrated the Coniferæ of Japan. The plants of the order Compositæ in Liebmann's collection, are said to comprise fully a thousand species: they are to be elaborated by M. Steetz.

Southern Ichthyology, or a Description of the Fishes inhabiting the waters of South Carolina, Georgia and Florida; I. E. Holbrook, M. D. 4to. *Philadelphia.* To be issued in numbers every two months; price one dollar each. Will be completed in two or three years.

Report of a Geological Exploration of part of Iowa, Wisconsin and Illinois, made under instructions from the Secretary of the Treasury of the United States, in 1839, by D. D. Owen; 192 pp., 8vo, with views, sections and numerous figures of fossils.

Medical application of Electricity, with description of apparatus and instructions for its use. 21 pp., 12mo, 1846. *Boston.*

Report on Standards of Weight and Measure for the state of Maryland, on the constitution of the yard measure, by J. H. Alexander. 214 pp., 8vo, 1846. *Baltimore.*

Transactions of the Linnæan Society; 4th part of vol. xix.

Annuaire du Bureau des longitudes pour l'année 1846. 1 vol. 18mo. *Paris.* 1*fr.* 50*c.*

Report on Zoology for 1843, 1844, (Arsberättelse om Zoologiens Framsteg, &c.,) by C. H. Boheman. 8vo, *Stockholm*, 1845.

Report by Berzelius on Chemistry and Mineralogy for the year 1845. (Arsberättelse om Framstegen i Kemi och Mineralogi af Jac. Berzelius.) *Stockholm*, 1845.

Experimental Researches in Electricity, by M. Faraday. Vol. ii, with 5 plates. *London.* 9*s.*

Traité élémentaire d'astronomie physique, par M. Biot. 4 vols., with 65 plates in three atlases, 3d edit. *Paris.* 49*fr.*

Recherches geologiques sur les iles de Ténériffe et de Fogo, par M. Ch. Delville. 1 vol., 4to, with plates. *Paris.*

Essai sur le Système Silurien de l'Amerique Septentrionale, by M. de Castelnau. 1 vol., 27 plates, 4to. *Paris.*

Leçons de geologique pratique, par L. Elie de Beaumont. Vol. i, 8vo, 1845. *Paris.* Will form three volumes.

Die im Bernstein befindlichen organischen Reste der Vorwelt, gesammelt in Verbindung mit Mehrehren bearbeitet und herausgegeben von Dr. Georg Carl Berendt. *Berlin.*

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